ANNALS

OF THE

Association of American Geographers

VOLUME IX, 1919

RICHARD ELWOOD DODGE, *Editor*

PUBLISHED BY THE ASSOCIATION
In Collaboration with the American Geographical Society

CONTENTS

Annals of the Association of American Geographers

Subscription $3.00 per volume unbound; $3.50 in bound form.

Communications should be addressed to
ANNALS OF THE ASSOCIATION OF AMERICAN GEOGRAPHERS
Broadway and 156th Street,
New York City

ANNALS OF THE ASSOCIATION OF AMERICAN GEOGRAPHERS,
Volume IX, pp. 3-11

THE CIRCUMFERENCE OF GEOGRAPHY*

NEVIN M. FENNEMAN

CONTENTS

INTRODUCTION.—It is a peculiarity of geography to be always discussing and debating its own content—as though a society were to be organized for the sole purpose of finding out what the organization was for. This is not said by way of criticism; indeed this very paper is a continuation of the same discussion. The situation is, however, unique and can scarcely fail to be remarked by on-lookers from other sciences, who have no such doubts as to what their subjects are about.

The basis of this constant concern is not greed but *fear*. Geography wages no aggressive wars and seems to covet no new territory. In certain quarters it bristles with defense; but it is mainly concerned with purging its own house rather than spreading its borders. To rule out "what is not geography" would seem from the discussions to be much more important than to find and claim geography where it has been passing under other names. The constant apprehension is that by admitting alien subjects we shall sooner or later be absorbed by a foreign power and lose our identity.

It is probably unnecessary to point out that this is purely an American attitude. Geography of the European brand has no such concern for its own purity or fear of being absorbed. Scholarly geographic treatises from Europe may contain long lists of botanical names, or geological descriptions, or chapters which might be transferred bodily to monographs on economics or history.

To many American geographers this would seem like betraying their cause and selling their birthright. There is an implied dread that if geography accepts the work and uses the language of other sciences, geography itself will be dismembered and its remains be divided among its competitors. It is worth while to consider this possibility, and a rough plan is here submitted for a partition of geography's domain.

* Presidential Address delivered before the Association of American Geographers, Baltimore meeting, December, 1918.

Suppose geography were dead, what would be left?

PROPOSED PARTITION OF GEOGRAPHY'S DOMAIN.—Geology might easily take over topography, including its genetic treatment, which is physiography—in fact, has never given it up. So also botany has never relinquished plant geography and ecology. Zoölogy does not

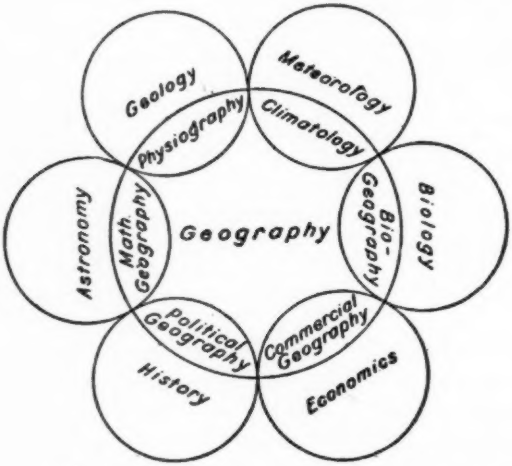


FIG. 1—This diagram expresses the fundamental conception that sciences overlap and that each one of the specialized phases of geography belongs equally to some other science. Such a diagram will be helpful if not construed too strictly. In a loose way the central residual part of the circle may represent regional geography.

forget the distribution of animals. Agriculture is now so specialized and so firmly entrenched that crops and their distribution, and their relation to all manner of factors, are studied without concern for geography. Meteorology has official standing in all civilized countries and could take care of climatology if geography were bankrupt. Moreover, meteorology is commercially employed and so has the satisfaction of being good for something beside being merely good "to teach." So it is not afflicted with heart searchings regarding its own content. Mining is abundantly treated by geology and economics. The geographer only borrows from these, smooths out their details, and relates their results to something else. So economics deals with all other industries and with commerce, sometimes availing itself of the aid of chemistry and other sciences and always paying its respects to engineering.

A good part of what is termed political geography is covered also by history, and history would be more rational if it included still more. Political science, ethnography, etc., cultivate other parts of the geographical field and do it more exhaustively than does geography. Mathe-

matical geography is, of course, pure astronomy, except for cartography, which is straight mathematics.

Thus it seems that, with geography dead, all its tangible effects would be claimed by relatives and the estate could be settled up. To say the least, this is disconcerting. The case is not made better by the reflection that a large number of educated persons would see no reason for objecting to such a solution, provided only that geography were preserved for children up to the age when serious study should begin.

Dependence of Geography on Other Sciences for Its Material.—At this point, while geography is confessing its limitations, it may as well be owned that, outside the field of exploration, the geographer is mainly dependent on others for his data. Aside from mere location, direction, and distance, almost every fact that he employs belongs quite as much to some other science. In so far as that fact represents a class, the entire class of facts is much more apt to be known exhaustively by the other science than by geography. If the geographer speaks of soils, the agriculturist knows more; if he speaks of mines, the geologist knows more; if the reference be to manufacturing, the economist's knowledge is more thorough, or at least more exhaustive; if the subject is the people, the ethnographer, sociologist, or economist has first-hand knowledge, and the geographer is generally a borrower; and so through the list. With respect to all these data someone else is the original student, the "authority," and the geographer is merely "informed." How often is a geographer called in as an expert, and in what lines? This question is not intended to suggest a wholly negative answer, especially in view of the fact that three of our members are at present in Paris on the staff of the Peace Commission and nearly one-half of our members have been engaged in some expert capacity during the war. It does not follow, of course, that all these were engaged as geographers.

Concession has here been made freely because scholars outside of geography know these facts to be true, and there is nothing to be gained by claiming more than we can defend. If geography is not worth while despite these admissions, its business may as well be wound up.

Need of a Synthetic Areal Science.—Reverting now to our former figure of speech, what has geography to say of its proposed demise, the division of its tangible effects and the settling of the estate? The obvious question arises: Would the decedent stay dead? If he were to come to life again, the situation would be embarrassing as between him and his relatives. Assuming that after his decease each of the branches named above as contributing to geography does its task

well with respect to Russia, for instance, is there any likelihood that a craving would arise for a synthetic picture of the whole or a critical study of inter-relations? If so, who would satisfy this craving, and who could paint the picture, and what would be its value or standing among scholars?

To begin with, the first question answers itself. There is not one chance in a hundred that ten years would go by without a conscious craving, and an attempt to meet the craving, for a comprehensive view of the areal unit; and not one chance in a million that a century would elapse before such an interest would be the center of a new science. It matters no whit that all concrete data are already organized into other sciences, each more exhaustive and more critical with respect to its own data than the new science; it is absolutely certain that interest in the areal unit as such would clothe itself in appropriate form. It is the *areal relation*, after all, that makes geography.

To dwell on the kind of picture to be painted is not within our present purpose. In part it is a mere assembling of facts from diverse fields, facts joined together by the sole bond of a common locality. Whether we deride or apologize for this aggregation of facts, call it mere description, mere compilation, mere this or mere that (whatever it is, it is always " mere "), this humble task must still be performed before higher work is possible. Description bears the same relation to geography that narrative does to history. There can be no sound philosophy in either, based on faulty narrative or description.

But data thus assembled from diverse fields do not remain inert. They react on each other like chemicals to produce new compounds, that is, new truths. If the geographer knows less about soils and crops than the agriculturist, less of climate than the meteorologist, less of industry than the economist, less of society than the sociologist, he should still be supreme in this field of secondary compounds which cannot be formed by those who handle the data of one science only.

Value of " Scientific Trespass."—This point needs no elaboration here, but it is worth while recalling a passage from the presidential address of Dr. G. K. Gilbert before this association in this same city ten years ago. In explaining his choice of a subject, he announced himself as an advocate of the principle of " scientific trespass." " The specialist who forever stays at home and digs and delves within his private enclosure has all the advantages of intensive cultivation—except one; and the thing he misses is *cross-fertilization.* Trespass is one of the ways of securing cross-fertilization for his own crops, and of carrying cross-fertilization to the paddock he invades."[1] Gilbert

[1] *Science*, Vol. 29, p. 122.

might have added that the geographer is, or should be, the great insect that carries pollen from field to field.

It is not intended here to concede that geography does not concern itself at all in the first-hand search for data. Geographers have, for example, done much for topography. Light on land forms has been by far the leading contribution of American geography (though it is a question whether anyone has contributed to this subject who was not first trained as a geologist).

Regional Geography the Core of the Science.—Since geography *is to be,* it is quite right that physiography and climatology and the study of natural resources and even ecology should be of its family and bear its name, but the point here urged is that these are not the things which make geography *necessary* and *inevitable.* They may be necessary to it, but it is not necessary to them. All these might live with geography dead. All these and others belong to the regions of overlap, or ground common both to geography and to some other science, and, having two parents, would not be totally orphaned if one died; but the study of areas as before described belongs solely to geography and is, moreover, an only child. If these figures are somewhat mixed, it may be well to add in plain English that the one thing that is first, last, and always geography and nothing else, is the study of areas in their compositeness or complexity, that is *regional geography*

It is not to be implied for one brief moment that physiography and the other branches named are not geography. They all become so when directed toward a geographic purpose. But without the touchstone of areal studies, there is nothing to make physiography other than geology, ecology other than botany, the study of natural resources other than economics.

There is, then, in geography this central core which is pure geography and nothing else, but there is much beyond this core which is none the less geography, though it belongs also to overlapping sciences. Here belong physiography and climatology, mathematical and commercial geography. Still, *the seeds are in the core, and the core is regional geography,* and this is why the subject propagates itself and maintains a separate existence. Without regional geography there is no reason why geography should be treated as a separate branch.

This emphasis on areal relations instead of on the " elements " which enter into such relations is, of course, not new. It comes to much the same thing in practice as Ritter's " home of man " or Davis's " physical element and human element " or this and that man's " responses " or Keltie's " science of distributions " or Hettner's *" dingliche Erfüllung der Erdräume "* (material filling of the earth's surface). Nor is it necessary, for the purpose here in hand, to point out that every element

(topography, vegetation, climate, etc.) can be treated with reference to its distribution as well as with reference to its types. Such a treatment belongs to regional geography. It should, however, be noted that the study of the distribution of any one element by itself falls somewhat short of that *distinctive* geographic flavor which comes only when the various elements are studied in their inter-relations.

Cultivation of the Central Theme of Geography as a Safeguard Against Absorption by Other Sciences.—Let us now go back to the fear above alluded to, that our subject is going to be swallowed by something else. Why this constant dread? The situation at once suggests that we live too much on our borders and not enough in the center. If we dwell mainly in systematic physiography, why should not geology claim us as a vassal? If we live largely in commercial geography, we are in similar danger from economics; and why should it not be so? We can go round the circle with the same logic. A narrowly political geography of boundaries and capitals never had any reason for a separate existence apart from history.

If we are concerned for our independent existence no amount of fortifying our border will take the place of developing our domain. What we need is more and better studies of regions in their entirety, their compositeness, their complexity, their inter-relations of physical, economic, racial, historic, and other factors. No other science can swallow that and live.

Unnecessary Discrimination Against Geologic Terms.—An illustration of warring on the border instead of farming our domain is found in our curious boycott of terms from other sciences even when needed to make the truth clear. It is not permissible to say that the Cumberland Plateau is co-extensive with the strong "Carboniferous" rock (even where that is true) or that the High Plains (of Nebraska and Wyoming) end at the north with certain late "Tertiary" formations. It is permissible to say that the Cumberland Plateau is as broad as certain "resistant" rocks, but a term which would enable us to locate those rocks on the geologic map is taboo. True, the plateau border can be made out on very large-scale and awkward-to-handle topographic maps, but such maps at best are empirical, while the geologic map is interpretative. Since when has geography become so reactionary? Why must we secrete the geologic map as medieval priests secreted the Bible?

In the debates concerning this point there has been the most curious oversight of common usage. "Carboniferous" and its like are dubbed "geologic time names." Such they are indeed, sometimes, just as "Carboniferous" might be the name of a man or a horse or a brand of

shoe polish—all as irrelevant as geologic time—but the term also designates a body of material (in this case a system of strata) and, more important still, on the geologic map its stands for an *area*. "Triassic" indeed connotes geologic time, but the same word designates certain areas on the geologic map of the eastern United States. "Portage" is not only a Devonian epoch but a belt on the geologic map of western New York, a belt that must be spoken of and cannot be designated with equal clearness under any other name. In this manner, much use is properly made of geologic terms, not because they are names of epochs but because they are names of areas that force themselves on our notice by certain peculiarities, thus leading to rational explanations. For three-fourths of the United States the geologic map is beyond comparison the one most valuable map for interpreting topographic contrasts between adjacent areas. Why must the words printed on it be classed as dangerous? The answer is: Geography is in danger of being swallowed, and self-preservation is nature's first law.

But "Cumberland Plateau" is a geographic term. How can the geologist say with impunity that the Carboniferous rocks are co-extensive with the Cumberland Plateau? Is not the danger mutual? Is his science not in danger of being swallowed by geography? The answer is: He is not afraid on that borderland where sciences overlap, because his own peculiar domain, which is not overlapped by geography or anything else, is too large and too well cultivated to admit of such fears. Our own safety lies in the same policy.

In our efforts toward self-preservation through purity, we have classed scientific terms as clean and unclean. The latter, such as Archean, Mesozoic, etc., cannot be touched without defilement. So we have built up a whole ceremonial by which we hope to be saved; but not so is salvation found. Its price to geography is no less than the diligent cultivating of its own peculiar field, the doing of something which the world needs and which no other science can do.

Animals have more than one way of evading the jaws of their competitors. The turtle is encased and puts up a good defense but is weak on the offensive. It is the same with the oyster. Others, like the squash bug, owe their safety to a peculiar flavor or odor. Still others specialize in modes of escape. But all such special provision belongs to the weak rather than to the strong. If geography will cultivate its own strength like the large mammals, it will not be necessary for it to encase itself like the oyster or cultivate the peculiar flavor of the squash bug to avoid being eaten.

In so far as there are frontiers between the sciences, let us have them ungarrisoned and let us have free trade. Let there be among sciences the same struggle for existence and law of survival that Darwin found

among species. Then every field of study that answers to an intellectual need will have due recognition.

THE SEVERAL SCIENCES DESIGNATED BY THEIR CENTERS, NOT BY THEIR CIRCUMFERENCES.—The subject announced for this brief address was "The Circumference of Geography." Presumably enough has been said to show that a science cannot be defined by its circumference. We may designate the center, and that should be enough. Everyone knows what botany is so long as we stay near the center, but where is its farthest limit? Far out in chemistry and medicine and geology, to say the least. And where is the limit of chemistry? Nowhere. Yet chemistry is not hard to define if it be designated by its center instead of by trying to draw its circumference. So the center of geography is the study of *areas,* generally, of course, in relation to man, for human habitation affords the most frequent utilitarian reason for such study and is also the center of the greatest intellectual interest; but the comprehensive study of an uninhabitable region would still be geography.

It is not only the right but the duty of every science to develop all parts of its domain, but it is none the less true of all, as of geography, that their right to separate existence depends on their cultivation of that part of their field which is not overlapped by others. Let there be no misunderstanding; there is no intention of assigning more dignity to one part of the field than to another or of asking any man to turn aside from that which interests him to something else. There is no more inherent worth in a center than in a border. But some of us have a philosophic interest in viewing relationships, and in asking why the whole range of knowledge has grouped itself around certain centers, and what it is that keeps those centers, which have received names, somewhat permanent, and what the advantage is in grouping knowledge around one center rather than another.

Moreover, all of us have a very practical interest in seeing that our own work should not suffer by isolation. We all want our own work to have the advantage of connections, and it is greatly to our interest that somebody should cultivate certain central fields even though most of us work on the borders. The logic of events, if no other logic, has brought together in this association a group of men of rather diverse interests. We are disposed to think that this is not a mere chance but that something fundamental underlies our union. Much that interests the individual does not concern the whole; but we feel more or less intelligently that there is profit in this intercourse and we want the relation to be closer. If there is a class of studies that will make our separate fields more important and more interesting to others and enable us to profit

more by our association, we want to know what that class is and to encourage it.

Beside those who are, first and last, geographers, our association contains geologists, topographers, geodesists, meteorologists, ecologists, zoölogists, geophysicists, historians, and economists. The list is not intended to be complete. We have joined ourselves together evidently expecting to find a common interest. Where is the common ground on which such diversity can meet? Interest in places, areas, regions is the common bond.

This quasi-philosophical study of relationships is therefore important to those whose privilege it is to direct research or to organize education. If men in such position decide with eyes open that physiography and commercial geography and anthropogeography and the rest should not be merely geology, economics, ethnography, etc., they must act accordingly. The character of these subjects cannot be controlled by ceremonial law. The effective way is to set in the midst of them a great light, the light which comes alone from the comprehensive, rational, systematic study of regions.

ANNALS OF THE ASSOCIATION OF AMERICAN GEOGRAPHERS
Volume IX, pp 13-37

CLIMATIC AND GEOGRAPHIC INFLUENCES ON ANCIENT MEDITERRANEAN FORESTS AND THE LUMBER TRADE

ELLEN CHURCHILL SEMPLE

The Mediterranean Basin is a climatic unit. It is a region of winter rains and summer drought, of warm summers and mild winters. The summer drought increases in length and intensity from north to south. The annual precipitation throughout the region as a whole is relatively scant, but it varies greatly from one district to another. It declines from north to south, from highland to lowland, and from the west side of peninsulas and islands to the east side. It ranges from 10 inches at Alexandria to 20 inches at sea level in Crete, 52 inches in Corfu, and over 60 inches on the Alps near Trieste; from 8 inches at Cairo to 36 inches in the mountainous littoral of Algiers; from 16 inches at Athens on the eastern side of Hellas to 40 inches in Cephalonia only 170 miles away on the western side, where the land lies exposed to the rain-bearing winds.* It is not the amount of the rainfall, however, but its seasonal distribution which characterizes the Mediterranean climate.[1]

This climate is due to the location of the Mediterranean Basin between two regions of sharply contrasted precipitation—between the tradewind or desert tract of Africa and the belt of the prevailing westerly winds, which all year round bring rain from the Atlantic to northern and middle Europe. The Mediterranean Basin occupies a transition zone between the two, and partakes in turn of the climatic character of each, according to the season of the year. In summer it approximates the arid conditions of the Sahara; in winter it reproduces the stormy skies and frequent rains of France and Germany; but the aridity is greatly attenuated along the northern rim of the Basin, and the rainy season is similarly attenuated along the southern rim, except

* NOTE.—After reviewing the evidence, the author has reached the conclusion that no appreciable change of climate has occurred in the Mediterranean region in historical times. Therefore recent rainfall statistics are cited.

[1] For general character of the Mediterranean climate and vegetation today, see
A. Philippson, *Das Mittelmeergebiet*, Leipzig, 1907.
Theobald Fischer, *Mittelmeerbilder*, Leipzig, 1908.
Naumann and Partsch, *Physikalische Geographie Griechenlands*, Breslau, 1885.
Wilhelm, Deecke, Italy, Trans. from the German. London.
R. Fitzner, *Niederschlag und Bewölkung in Kleinasien*, *Peterm. Georg. Mitt. Ergänzungsheft*, vol. xxx, No. 140. Gotha, 1903.
F. Trzebitsky, *Niederschlagsvertheilung auf. der Sudost Europäischen Halbinsel*, *Peterm. Geog. Mitt.*, vol. 55, Gotha, 1909.
M. Newbegin, The Modern Geography, New York and London, 1911.

where the high Atlas Mountains make a local area of heavy precipitation.

The Mediterranean Basin as a whole is distinguished not only by a common type of climate, but by a type of vegetation whose common physiognomy reflects the prevailing climatic conditions. Thus the ancients described it, and thus we find it today. Trees, shrubs, herbs and grasses in their structure and life course show a close adaptation to their environment. Many of them which were immigrants from northern Europe and central Africa became modified to suit Mediterranean conditions of climate and soil.

Like the Mediterranean climate, Mediterranean vegetation shows a series of graduated transition forms. On the north it merges into the plant life of middle Europe with its dense forests, abundant deciduous trees, juicy grasses and weeds, which are amply watered by the rains all year round, grow during the summer heat, and rest during the winter cold. On the south it gradually passes over into steppe and desert vegetation adapted to arid conditions—a sparse growth of thorny or spiny shrubs armed to resist the prevailing drought and to conserve the meager store of water which they get during the winter showers. Mingled with these shrubs is an equally sparse growth of grasses and herbs which spring up in moister districts after the winter rains, hasten through their few weeks of life, and die down under the parching summer heat. In desert and steppe alike the growth is thin; each plant stands apart from its fellows in an effort to monopolize a maximum space for its thirsty roots.

In type and in location the Mediterranean vegetation stands between these two contrasted groups of plant life. It knows neither the blessing of the all-year rainfall, nor the curse of Africa's aridity, but it has a taste of the latter in the long summer drought, while in the winter rains it gets the abundant moisture of the north, combined with sufficient warmth to keep its life processes going. In winter and spring, therefore, it has its period of growth, and in summer its period of rest. To these natural conditions it has adapted itself, and under them it has spread over Mediterranean lands as far as Mediterranean climatic influences penetrate. It finds its limit not far from the sea itself, because this body of water is the main reservoir of the winter moisture. At a relatively short distance back from the coast the typical Mediterranean vegetation gives place to steppe vegetation, as in Africa, central Spain and Asia Minor. In the mountains, where the winters are colder and the summers moister, it merges into a highland vegetation which closely resembles that of middle Europe, and in higher altitudes it passes over into Alpine types. The genuine Mediterranean vegetation, therefore, belongs to the lowlands and to the vicinity of the coasts. It is most typical in the middle zone of rainless summers found

in southern Spain and Italy, in Greece and Palestine. Farther south it is gradually transformed into the plant life of the steppes; farther north it merges into that of middle Europe.

In this broad transition zone, cereals and other grasses, having superficial roots and hence depending on the surface moisture in the soil, sprout during the warm rains of autumn, grow slowly during the winter, rapidly during spring, and reach maturity in early summer. After this they dry up in the drought and heat. Tuberous, bulbous and annual plants, likewise dependent upon surface moisture, are reawakened to life by the first warmth of spring, grow and blossom and seed while the soil is still damp, thus completing their life processes before the summer drought. To these groups of plants belong the chief crops of cereals and vegetables raised by Mediterranean agriculture. Therefore, from time immemorial winter has been the period of tillage in Mediterranean lands for all native crops, spring or early summer the harvest time, and middle or late summer a season of comparative leisure for farm labor.

Plants and trees that weather the long summer are equipped to resist drought. Many have elaborate root systems, which enable them to gather in moisture from a large area and especially from the deeper layers of soil. Their leaves are commonly narrow, often needle-shaped, so that they present the least possible surface to the sun. Some take the form of spines and thorns, which indicate approach to desert conditions. The leaves have a dark green or gray color, with a polished or resinous surface above and a silvery coating of hairs beneath. All these are nature's devices to diminish evaporation and thus conserve moisture in the plants. Many species of trees are dwarfed and gnarled, with stocky trunks and low branches hugging the ground, where rest the moister strata of air; for the higher the trees, the more they are exposed to the drying action of the winds. Others that grow tall, like the cypress, spring up into a slender spire of dark green, presenting little surface to the sun. Trees and shrubs at sea level are evergreen or nearly so. Even deciduous trees lose their leaves for only a brief space, because they need both the winter rain and summer heat to complete their life functions.

Mediterranean forests reflect the vicissitudes of their life conditions embodied in the long summer drought. The dense continuous forests which stretch across middle and northern Europe under the influence of an ample and well distributed rainfall reach their southern limit just within the northern border of the Mediterranean Basin. Beyond this margin, life conditions fluctuate or fail; the summer water supply is inadequate. Each tree, therefore, appropriates a large area with its spreading roots in order to get sufficient moisture. Consequently Mediterranean forests are usually sparse woodlands or savannahs, open

plantations into which the light penetrates. Genuine forests of the European stamp are found only on the northern rim of the Basin and on high mountains which are able to condense moisture from the summer clouds. They are ample on the Pyrenees, Alps, northern Apennines, the Macedonian highlands, and the mountain coasts of the Black Sea. In southern districts they occur as islands of green foliage on lofty mountains, like the peaks of Sicily, Arcadia, Crete and Cyprus, and especially on westward facing slopes like Mount Amanus and Lebanon. Palestine, even in very early times, knew no forests except the pine woods of Mount Hermon, firs and cedars of Lebanon, and the oak groves of Bashan or Gilead. Scarcity of timber made tall trees conspicuous landmarks and even objects of worship. In the southern lowlands forests degenerate into poor scrub growth, or shrink to detached groups of trees about a spring pool, or contract to a narrow ribbon of foliage along a wadi bed, or are replaced by irrigated plantations of domestic trees as in Egypt, or they succumb to the power of the desert.

The mountains of the Mediterranean Basin show climatic zones of altitude with their appropriate tree growth. On lower slopes the forests consist of mountain pine and evergreen oaks, up to an altitude of 2,000 or 3,000 feet. Above that height grow deciduous trees, like the oak, elm, chestnut and beech; at this elevation they get enough rain to do their life work in summer, when they also get more heat than the winter affords. The chestnut grows at altitudes from 2,000 to 5,000 feet according to the latitude; above it is the beech, and higher still are firs and cedars. Deciduous trees increase in abundance from lower to higher altitudes and from south to north. This is also the ancient distribution described by Theophrastus and Pliny. Theophrastus found the water-loving plane-trees lining the banks of the perennial rivers of Greece;[2] and today the modern traveler, tramping through the Vale of Tempe along the swift-flowing Peneus, enjoys their grateful shade.

The dense forests that covered the mountains along the northern rim of the Mediterranean Basin undoubtedly intensified their barrier nature in ancient times, and helped to discourage invasion by the pastoral nomads of the Eurasian grasslands. The wooded heights of the Caucasus, Balkans and Carpathians probably deflected many a migration away from Asia Minor and Greece, and turned it westward over the open plains of the lower and middle Danube towards Italy and Gaul. But these thick border forests once passed, the early peoples who pushed their way into Mediterranean lands found easy going for themselves and their wide-horned cattle through the open woodlands of the valleys and coastal plains. When they halted to make permanent settlements,

[2] Theophrastus, *De Historia Plantarum*, Bk. iv, ch. v, 6.

they had only thin forests to clear before sowing their crops. This consideration must have been an important factor in territorial expansion in the days when stone and bronze axes were the only weapons of attack upon hardwood trees. Indeed, history gives us hints that the primeval forests of Cyprus[3] and Corsica[4] were a deterrent to the earliest Greek and Roman settlements on these islands.

The relative paucity of trees in the lowlands and coastal strips, just where population settled thickest, resulted in a rapid denudation of the forests about the ancient cities and towns. This in turn gave rise to early importation of various woods from better timbered regions to deforested districts like Attica, and to forestless areas like Philistia and Egypt, whose local species of trees yielded little or no lumber. The result was the very early development of the lumber trade. This supplied the demand for fuel, building materials, cabinet woods and ship timber; the latter included special kinds of lumber for keel, hull, decking, masts and oars.

Owing to the diminution of rainfall from north to south, from west to east, and from highland to lowland, these were exactly the directions in which the chief lumber traffic moved. Exceptions occurred mainly where choice woods from a limited area of production gradually acquired wide use, as in the case of the tall pines of the Caucasus and the unsurpassed cedars of Lebanon. The ebony and teak imported from India over the eastern rim of the Basin met a demand in all the capital cities.

The wide distribution of mountains within and around the Mediterranean Basin made the highlands the predominant source of lumber from the earliest historical times. In the Iliad, Achilles sent mules and wood cutters to Mount Ida to bring oak for the funeral pyre of Patroclus down to the Trojan plain. Later Priam got the fuel for the pyre of Hector from the same source.[5] Mount Pelion furnished the shaft of ash for the spear of Achilles.[6] Sarpedon fell in battle "as falls an oak or silver poplar or a slim pine tree that on the hills the shipwrights fell with whetted axes, to be timber for ship-building." The roar of conflict about the dead Sarpedon was "as the din of woodcutters in the glades of the mountains."[7]

The scant rainfall of the Eastern Basin except on the highlands emphasized the value of the mountain forests. Therefore, the ancients had a sharp eye for this source of their lumber supply. Homer speaks

---

[3] Strabo, Bk. xiv, ch. vi, 5.

[4] Theophrastus, *Hist. Plant.*, Bk. v, ch. viii, 2.

[5] Iliad, xxiii, 118-121; xxiv, 663.

[6] Iliad, xix, 390-392.

[7] Iliad, xvi, 482-384; 634-636.

of "the topmost crest of wooded Samothrace;"[8] Hesiod knew "where oaks the mountain dells imbranch on high,"[9] and Aristophanes "the wood-crowned summits of the lofty mountains."[10] Theophrastus, discussing the tree life of the Eastern Basin, alludes to the woodlands of the plains, but discourses at length on the important forests of Lebanon and Taurus mountains, Mt. Tmolus of Lydia, the Mysian Olympus, Mt. Odynnos of Lesbos, Phrygian Ida, Mt. Cytorus and the other Pontic ranges of Asia Minor, Haemus and other Thracian mountains, the Macedonian highlands, Thessalian Olympus, the high wooded ridges of Magnesia, certain ranges of northern Hellas, Mt. Parnassus and certain peaks of Euboea, Mt. Cyllene and the Arcadian highlands in general, Mt. Ida of Crete and the Leuca ranges in the western part of that island.[11] He repeatedly emphasized the general superiority of mountain woods for timber purposes, even where a given species of tree grew alike in highland and lowland and reached a taller growth in the more fertile soil of the plain. In the case of mountain trees, he discriminated in favor of forests covering the high level stretches or terraces of plateau and range, as against the stunted timber of the lofty summits.[12] It is a striking fact also that Theophrastus constantly cites the classification, nomenclature and description of trees current among the people of Phrygian Ida, Macedonia and Arcadia.[13] All these were mountaineers, backward in the culture prized by the Attic Greeks, but evidently recognized authorities in everything pertaining to forestry and lumbering.

Pliny, who enumerated the lumber resources of the whole Mediterranean Basin, also noted that the quality of trees depended upon their place of growth. According to him, the best Italian timber came from the Alps and Apennines, the best Gallic woods from the Jura and Vogesus ranges. The Gallic lumber was doubtless floated down the Rhone and Saone to the Mediterranean. Other well-known lumber regions which he enumerated were all mountainous—Corsica, the Pyrennees, Bithynia, Pontus, Macedonia, Arcadia, Crete, the Lebanon district of Syria, and the coast ranges of Roman Africa which yielded the famous Atlas cedars.[14]

As the mountains of the Mediterranean Basin rise almost everywhere directly from the sea, the logs were floated down the drainage

[8] Iliad, xiii, 13.

[9] Hesiod, Work and Days, ii, 203.

[10] Aristophanes, Clouds, 281.

[11] Theophrastus, *Hist. Plant.* Bk. iii, ch. ii, 5, 6; ch. iii, 2-4; ch. v, 1; ch. ix, 5; ch. x, 6; ch. xv, 5; xviii, 3-6, 13. Bk. iv, ch. 1, 2-3; ch. v. 2-7.

[12] Ibid. Bk. iii, ch. iii, 2.

[13] Ibid. Books iii, iv, and ix, *passim.*

[14] Pliny, *Historia Naturalis,* Bk. xvi, chs. 15, 16, 18, 39. Bk. xiii, chs. 15, 16.

streams in flood time to the nearest harbor, whence they were exported. Ancient writers frequently emphasize the accessibility of the timber supply to the coasts. Tyre and Sidon were great lumber ports from early times. When King Hiram made a contract with Solomon to furnish the wood for the new temple of Jerusalem, he sent his expert lumbermen up into the Lebanon ranges and collected the cedar and pine logs (translated "fir" in the Bible) at Tyre. There he made them into rafts and had them towed down the coast to Joppa.[15] Both Tyre and Sidon furnished cedars for the rebuilding of the Jewish temple after the Babylonish captivity, and transported them by sea to Joppa.[16] The various woods of Mount Ida in Phrygia reached Mediterranean trade through the port of Aspaneus, located near the head of the Adramyttene Gulf.[17] Forests which did not command easy transportation to the coast long escaped the woodman's axe, or supplied merely local needs unless general scarcity of timber intensified the demand. After the Macedonian conquest of Cyprus, the Greek kings of the island began to conserve the valuable cedars of their mountains when it proved to be a losing business to pay the freight charges from the interior to the coast.[18]

The Mediterranean lumber trade was more active in the Eastern Basin than in the western, because of the very irregular distribution of forests and the meagre tree growth around the Levantine and Aegean seaboard. The chief importers of lumber were the populous maritime cities surrounding the Aegean, who wanted it for their big merchant marine and various domestic purposes. They used the woods of coniferous trees, like fir, various pines, juniper and cedar primarily for ships,[19] but employed them also extensively in the construction of buildings. Cypress, laurel, box, olive, poplar, maple, wild fig, larch, chestnut, walnut, beech, oak, elm, ash, mulberry, plane and holly were used for carpentry and cabinet work.[20] Keels of ships were occasionally reinforced with oak for greater strength,[21] or with beech when they had to be hauled.[22] The modern is often amazed at the ancient use of woods for manufacturing or building purposes which are now regarded fit only for fuel or wood pulp.

Many woods were widely distributed over the Mediterranean Basin, like the box, olive, fig, various oaks and conifers. Some were found chiefly in southern lands, like the cypress in Cyrene, Crete, Rhodes

[15] II Chronicles, ii, 16. I Kings, v, 5-12.

[16] Ezra, iii, 7.

[17] Strabo, Bk. xiii, ch. i, 51.

[18] Theophrastus, *Hist. Plant.* Bk. v, ch. viii, 1.

[19] Ibid. Bk. iv, ch. v. Bk. v, ch. 7-8; ch. vii, 1-3, 5; ch. viii, 1-2.

[20] Ibid. Bk. v, ch. iii, 1-7; ch. iv, 1-2; ch. vii, 4-8.

[21] Ibid. Bk. v, ch. iv, 3; ch. vii, 6.

[22] Ibid. Bk. iii, ch. x, 1. Bk. v, ch. vii, 2.

and Lycia,[23] and the palm in the desert belts. Those which supplied the best and most abundant lumber grew on the western slopes of high mountains or in the northern zone of the Mediterranean Basin.

The whole African coast of the Eastern Basin was practically lacking in timber, owing to the semi-desert conditions. The Egyptians cut short planks three feet long from the local acacia trees for constructing their river transport boats,[24] and they utilized the wood of the olive, sycamore (Ficus Sycamorus), *balanos* and doum-palm for cabinet and carpentry work in lieu of anything better.[25] The paucity of their wood supply is indicated by their skiffs made of bundles of papyrus reeds, after the manner of the balsa boats of Lake Titicaca in Peru, and by the use of the papyrus root as fuel. The highland oasis of Cyrenaica had olive, lotus and cypress trees, of which only the last could be used primarily for lumber.[26] The thuya or thyon tree (Callistris quadravalvis), a juniper nearly related to the cypress, grew abundantly in Cyrenaica and the oasis of Ammon in the fourth century B. C. It furnished material for roofs in very ancient times, but as the wood was fragrant and proof against decay, it was valuable for cabinet work.[27] It entered into the trade of the Eastern Mediterranean by way of Crete or Egypt. Homer makes Calypso burn it with cedar and larch to perfume her grotto, and the Book of Revelations, written in the latter part of the first century A. D., alludes to it as a choice wood of commerce.[28]

The absence of forests and paucity of timber trees made these regions of lowland north Africa importers of lumber. The same conditions held in Palestine and the low Philistian coast. Their nearest source of supply lay in the cedar forests of Lebanon, the pine woods of Mount Amanus, which forms a northern extension of the Lebanon range, and the wooded heights of Cyprus. Hence these forested districts were national possessions envied by all the countries around the Levantine Sea. The timber of Mount Amanus and Lebanon occasioned the repeated conquest of these ranges by Egypt in the south and especially by Babylonia in the arid southeast, which had imported thence building material for its temples since 3000 B. C. or earlier.[29] It supplied wood for the Phoenician export trade in cedar and pine logs to Palestine and Egypt,[30] and for countless Phoenician fleets. Tyre secured

[23] Ibid. Bk. iii, ch. i, 6; ch. ii, 6. Bk. iv, ch. iii, 1; ch. v, 2.

[24] Herodotus, ii, 96.

[25] Theophrastus, *Hist. Plant.* Bk. iv, ch. ii, 2, 6-9.

[26] Ibid. Bk. iv, ch. viii, 4.

[27] Ibid. Bk. v, ch. ii. 7.

[28] Odyssey, v. 60. Revelations, xviii, 12.

[29] F. Hommel, *Geschichte von Babylonien und Assyrien*, pp. 328-330. Berlin, 1885.

[30] J. Breasted, History of Egypt, pp. 95, 114-115, 127. New York, 1909.

ship timber also from the coniferous forests of Mount Hermon, whose great height (8,702 feet or 2,653 meters) insured summer showers, and it imported oak for oars from Bashan.[31]

The mountain forests of Cyprus, together with the copper mines, doubtless furnished the motive for the Phoenician conquest of the island in the eleventh century B. C. Even at this early date the necessity of conserving the Lebanon timber may have become apparent, since the pine groves of Amanus had long before this been seriously invaded. Forests renewed themselves with difficulty under the climatic conditions of the Eastern Mediterranean. For centuries the Cyprian ranges furnished excellent cedar for ship-building; the Greek kings after the Macedonian conquest began to conserve the forests, which were evidently declining in extent and retreating from the shore.[32] Theophrastus states that in his time (313 B. C.) the Syrians and Phoenicians made their triremes of cedar because they had no fir and little pine timber, but that the Cypriots generally preferred Aleppo pine for this purpose because it grew abundantly on the island and was superior to their other woods.[33] Strabo, on the authority of Erastosthenes, states that the forests of the Cyprian plain were once so dense that they formed an obstacle to tillage; that though they were invaded for fuel to smelt the copper and silver from the local mines, and for timber to build whole fleets of ships, nevertheless, consumption did not keep pace with the growth of the forests until, by legal enactment, the act of clearing the land was made to convey title to it.[34] So dense a mantle of trees would indicate a heavier rainfall in Cyprus than the meager 15 inches (37 centimeters) recorded in recent decades. Erastosthenes' account, however, may be based upon traditions of the Bronze Age, when the people of the island had imperfect tools for clearing even their woodlands, and moreover, devoted their energies to mining rather than to agriculture. Yet even in Strabo's time a forest covered the western promontory of Acamas, which was exposed to rain-bearing winds.[35]

The high Taurus Mountains, which wall in the coast of Cilicia Trachea, Pamphylia and Lycia in Asia Minor, get today from 30 to 40 inches of rain (75 to 100 centimeters) from the southwestern storms. The Pisidian Taurus range, back of the Gulf of Adalia, abounded in forests in ancient times. It was drained by the Eurymedon and Melas rivers, which were apparently used as log streams to float lumber down to the coast; because between them lay the seaport

[31] Ezekiel, xxvii, 5, 6.
[32] Theophrastus, *Hist. Plant.* Bk. v, ch. viii, 1.
[33] Ibid. Bk. v, ch. vii, 1.
[34] Strabo, Bk. xiv. ch. vi, 5.
[35] Strabo, Bk. xiv, ch. vi, 2.

of Side, where the Cilician pirates placed their shipyards.[36] The Cilician and Lycian Taurus produced fine cedars,[37] which the pirates used for their swift-sailing boats. The Persians also utilized these timber supplies in the shipyards which they maintained on the Cilician coast. There Artaxerxes in 460 B. C. built three hundred triremes for an attack on Egypt.[38]

After the Roman conquest the chief lumber port of this coast was Hamaxia,[39] near the site of modern Alaja. Just behind this town the Taurus Mountains rise to 10,266 feet (3,130 meters) and therefore get ample precipitation for forests, though the seaboard receives less than 20 inches. All this region was comparatively near Egypt and desirable to her for its timber. Hence that country, whose palm trees yielded poor lumber and whose irrigated fruit trees were too valuable for that purpose, maintained sovereignty over all or part of this forested mountain coast for nearly three hundred years after the break-up of Alexander's empire (323 B. C.). In 300 B. C. the Ptolemies owned Cyprus and the whole southern coast of Asia Minor from Rhodes and Lycia to Issus, but by 218 B. C. their possessions had shrunk to Cilicia Trachea and Cyprus.[40] These were retained till 67 B. C. and 58 B. C., respectively, when they were conquered by Rome; but later Mark Anthony assigned Hamaxia and the neighboring coast of Cilicia Trachea to Cleopatra to furnish wood for the Egyptian fleet.[41] In the thirteenth century Hamaxia had a successor in the port of Alaya, where the Seljuk Turks had shipyards for their navy.[42] So the Cilician forests persisted.

It was especially the northern mountains of the Mediterranean Basin, with their heavier rainfall and denser forests, which yielded the most ample and varied supply of timber, and which, therefore, furnished the chief cargoes for the lumber fleets of ancient times. These cargoes included other ship supplies besides woods, namely, pitch for caulking the seams of vessels, and wax for the encaustic painting of the hulls to make them impervious to water. It is a significant fact that wax and honey invariably figure as forest products in ancient Mediterranean trade, doubtless because numerous flowering trees and shrubs like myrtle, laurel, oleander, tamarisk, hawthorn, lime or linden, wild apple and pear mingled with other forest growth

[36] Strabo, Bk. xii, ch. vii, 3. Bk. xiv, ch. iii, 2.

[37] Theophrastus, *Hist. Plant.* Bk. iii, ch. ii, 6. Pliny, *Hist. Nat.* xvi, 32.

[38] Diodorus Siculus, Bk. xi, chs. 60, 75, 77.

[39] Strabo, Bk. xiv, ch. v, 3.

[40] E. A. Freeman, Historical Geography of Europe, Atlas, maps vi, viii, ix. London, 1882.

[41] Strabo, Bk. xiv, ch. v, 3.

[42] Guy Le Strange, Lands of the Eastern Caliphates, p. 142. Cambridge, 1905.

and provided honey pastures for the bees. The rainy slopes of the Caucasus Mountains overlooking the Euxine yielded various timbers, especially those suitable for ship-building, besides wax and pitch in great abundance. These forest products were conveyed down the River Phasis to Colchis, whence they were exported.[43] They equipped the navies of Mithridates. Pontic pines, famous for ships, besides other woods used by builders and wheelwrights, were imported into Italy from the Caucasus forests during the last century of the Roman Republic.[44]

Along the northern shore of Asia Minor, from Colchis to Heraclea Pontica and Calpe[45] in Bithynia, the high Pontic ranges facing the Euxine winds were mantled with forests of excellent ship timber, besides oak, elm, chestnut, ash, maple and a superior variety of box. These woods could be easily conveyed away, Strabo tells us. They entered the Mediterranean trade through the ports of Cerasus or Pharnacea, Amisus, Synope and Amastris.[46] The walnut wood exported from Synope was a fine variety used for making table tops. Box trees grew in such perfection and abundance on the Cytorus range[47] in the coastal belt of Paphlagonia that they became proverbial and gave rise to the saying "carrying boxwood to Cytorus," equivalent to the English "carrying coals to Newcastle." The box yielded a very hard close-grained wood, almost proof against decay, used for the manufacture of sacred images, carpenters' tools, flutes and combs.[48] It was evidently imported into Italy for these purposes, for its fame is sung by Vergil, Catullus and Ovid, who always specify the Cytorian or Phrygian variety of box.[49]

In western Bithynia the mountains decrease in height, the rainfall of the Asia Minor coast declines to 28 inches (700 mm.), but the summer showers suffice for the forests. Near the Propontis, the Mysian Olympus rises to the height of 8,300 feet in the face of the Pontic winds, and receives enough precipitation (over 32 inches or 800 mm.)[50] for large, diversified forests.[51] In ancient times its export

[43] Strabo, Bk. xi, ch. ii, 15-18.

[44] Vergil, Georgic II, 440-445, Horace *Carmina*, I, 14, 11.

[45] Xenophon, Anabasis, Bk. vi, ch. iv, 4, 5.

[46] Theophrastus, *Hist. Plant.* Bk. iv, ch. v, 3, 5. Bk. v, ch. vii, 3. Strabo, Bk. xii, ch. iii, 10.

[47] Pliny, *Hist. Nat.*, Bk. xvi, 16. Theophrastus, *Hist. Plant.*, Bk. iii, ch. xv, 5.

[48] Theophrastus, *Hist. Plant.*, Bk. i, ch. v, 4, 5. Bk. v, ch. iii, 1, 7; ch. iv, 1, 2; ch. viii, 8.

[49] Catullus, iv, 3. Vergil, Georgic II, 438. Ovid, Metamorphoses, iv, 311.

[50] R. Fitzner, *Niederschlag und Bewölkung in Kleinasien*, pp. 78-80, rain fall map, p. 91. *Pet. Geog. Mitt, Ergänzungsheft*, vol. xxx, No. 140. Gotha, 1902.

[51] Theophratus, *Hist. Plant.*, Bk. iii, ch. ii, 5. Bk. iv, ch. v, 3. Strabo, Bk. xii, ch. viii, 3, 8.

timber was floated down the Rhyndacus River to the sea,[52] and probably marketed through the Milesian port of Cyzicus. Mysian Olympus and Phrygian Ida furnished to the Aegean world varied and abundant timber, but little that was suitable for ship-building, according to Theophrastus.[53] The fir and pine forests of these ranges were probably approaching exhaustion in his time, 313 B. C. Mt. Ida's proximity to the fertile Trojan plain and the nine successive cities on the site of Ilium would suggest long exploitation of its best lumber. The process went on as late as 424 B. C. after the Athenian conquest of Lesbos, when refugees from the island occupied Antandrus on the mainland near by, and planned to build a fleet from the forests of Mt. Ida, for the purpose of harassing Lesbos and the neighboring coast cities of the Athenian league.[54]

The Aegean front of Asia Minor receives an average rainfall of 25 inches in the lowlands (Smyrna 26 inches or 650 mm.). This is scant allowance for forests, especially in view of the almost rainless summers. The whole region, however, from the Troad to Caria and Rhodes is crossed by numerous short mountain ranges in close proximity to the sea; their peaks, rising from 3,500 to 4,100 feet and receiving about 30 inches or 750 mm. of rain,[55] doubtless offered in ancient times sufficient timber for the needs of the early Phoenician and Greek colonies along this coast. Forested promontories and island peaks, like Mimas (3,803 feet or 1,190 meters), Mycale (4,150 feet or 1,265 meters), Mt. Atabyrius in Rhodes (4,067 feet or 1,240 meters) and Mt. Pelinnaeus in Chios (4,147 feet or 1,264 meters), were probably one attraction to settlers who sought the deep-running inlets for their new homes. The ranges were neither long nor very high, however, and had evidently lost much of their forest covering by the Christian Era. Theophrastus mentions only the woods of the Phrygian Mountains, which lie farthest north, and those of the Tmolus Mountains in Lydia, which, however, yielded no ship timber.[56] In Strabo's time, the bold sea-washed ridges of Mycale and Mimas were still well forested and harbored abundant game, while the hill country of Ortygia near Ephesus had woods of various trees, especially cypress groves.[57] The latter doubtless furnished the famous doors of the temple of Diana, but the cedar planks for its roof[58] were undoubtedly imported from Crete, Lycia, Phoenicia or Cyprus. The early exhaus-

[52] Theophrastus *Hist. Plant.*, Bk. v, ch. iii, 1.
[53] Ibid. Bk. iv, ch. ii, 5.
[54] Thucydides, iv, 52.
[55] R. Fitzner, *opus cit.* rainfall map, p. 91.
[56] Theophrastus, *Hist. Plant.* Bk. iv, ch. v, 3, 4.
[57] Strabo, Bk. xiv, ch. i, 12, 20, 33.
[58] Vitruvius, *De Architectura*, Bk. ii, ch. ix, 13. Pliny, *Hist. Nat.*, xvi, 79.

tion of the local supply of ship timber forced the big trading cities of this coast to search for it abroad. Miletus, which required much timber for her merchant marine, may have established her Pontic colonies of Synope, Amisus, Cerasus and Trapezus partly for the purpose of controlling her own ship supplies. Even Cyzicus could furnish timber from Mysian Olympus.

The busy maritime cities of eastern Greece, located in the rain shadow of the Grecian highlands, were even more dependent upon imported lumber, because their local hills and mountains, according to Theophrastus, yielded only inferior woods. Megara, when she founded the colony of Heraclea Pontica on the Euxine, selected a spot which today, as the modern Eregli, has the reputation of being unusually rainy and well timbered.[59] Heraclea was therefore designed to exploit for Megara's benefit the forests of the Pontiac ranges as well as the abundant yield of the coast fisheries there. Athens, whose local mountains were practically denuded of their forests in the time of Plato,[60] brought lumber from great distances, both for naval purposes and for building. Even fencing and beams for the Laurion mines came from over sea.[61] The construction of lumber rafts equipped with sails was familiar to the Greeks. Athens occasionally secured ship timber from Phoenicia or Cyprus, and undoubtedly organized her vast Pontic trade in the days of her maritime empire with a view to the importation of Pontic lumber. She drew also upon the forest supplies of the west. The speech of Alcibiades revealing to the Spartans the Athenians' motives for the Sicilian Expedition specifies the control "of the ship timber which Italy supplies in such abundance,"[62] and points to an established lumber trade with the Greek colonies of Magna Graecia and Sicily. A century later Theophrastus shows so detailed a knowledge of Italian woods[63] as to indicate their presence in the Athenian market, whither they had come in exchange for manufactured Greek wares. "The tall pines and crested oaks" of Sicily had been famous from Homeric days.[64]

The nearest and most abundant supply of good ship timber for the cities of eastern Greece was found in Thrace and Macedonia,[65] where a northern location, moderate summer showers and extensive mountain ranges insured considerable forests. The best watered and therefore

[59] R. Fitzner, *opus cit.*, p. 80. E. Banse, *Die Turkei*, p. 83. Berlin, 1919.

[60] Plato, Critias, chap. v, p. 418. Trans. by Henry Davis. London, 1870.

[61] A. Broeckh, The Public Economy of Athens, p. 138. Trans. from German. Boston, 1857.

[62] Thucydides, vi, 90.

[63] Theophrastus, *Hist. Plant.*, Bk. iv, ch. v, 5.

[64] Odyssey, ix, 112-120, 186.

[65] Xenophon, Hellenes, Bk. vi, ch. i, 11.

the best wooded section lay between the Strymon and Hebrus rivers. The coastal plain here receives about 25 inches (625 mm.) of rain annually, but the great Rhodope highland forming its hinterland has 30 to 40 inches or more (750 to 1,000 mm.).[66] There at the mouth of the Strymon River lay the important Athenian colony of Amphipolis, founded only after repeated efforts, owing to the hostility of the local tribes.[67] Significantly enough, its site had previously been selected by an abortive colony from Miletus.[68] Contiguous to this region, less rainy, but offering protected sites for coast settlements, was the Chalcidice Peninsula, colonized by Chalcis, Eretria, Andros and Corinth. All these cities doubtless counted chiefly on the forest products among the raw materials which were the natural exports of a new and backward region.

Theophrastus recognized the general superiority of the northern timber.[69] The woods imported into Hellas for building and carpentry work he graded according to quality, as follows: Macedonian, Pontic, Mysian-Olympian, Aenianian from the high slope of the Oeta (7,078 feet or 2,158 meters) and Tymphrestus ranges (7,606 feet or 2,319 meters) in northern Hellas, down to the poor knotty timber from Mount Parnassus and the Euboean ranges. Wood of variable quality was also brought from highland Arcadia,[70] where the peaks have considerable forests even today. All the maritime cities made a steady demand for the strong, light, durable Macedonian fir, which was used for oars, masts and sailyards. Athens imported this timber through her colony of Amphipolis, which commanded the forests of the Strymon River basin. Therefore she was dealt a heavy blow when this town and its port of Eion were captured by the Spartans in 424 B. C. during the Peloponnesian War, since her navy needed constant replenishing.[71] Later the expansion of Macedon over all this coast as far as the Hellespont excluded Athens from her nearest and surest lumber supply, and jeopardized her sea connection with the Caucasus and Pontic forests, until her incorporation into Phillip's empire again opened these sources of supply. Athens revolted from Cassander in 305 B. C. and forfeited her right to use the Macedonian forests. Then she turned to Demetrius of Syria and was promised timber for a hundred war ships.[72] The wood doubtless came from the Lebanon range.

---

[66] F. Trzebitsky, *Niederschlagsvertheilung auf der Sudost-Europaischen Halbinsel*, *Pet. Geog. Mitt.*, vol. lv, pp. 186-7. Gotha, 1909.

[67] Thucydides, i, 100; iv, 102.

[68] Herodotus, v, 124-126.

[69] Theophrastus, *Hist. Plant.*, Bk. i, ch. ix, 2.

[70] Ibid. Bk. v, ch. ii, 1.

[71] Thucydides, iv, 108.

[72] Plutarch, Lives, Demetrius, x.

The Macedonian forests long remained the chief source of lumber for the Aegean states.[73] In 158 B. C. we find Rome prohibiting the export of ship timber from Macedon, evidently as a measure to cripple the commerce of Rhodes,[74] which was then the great middleman of the Aegean. These forests were not exhausted in Strabo's time, because the town of Datum near the mouth of the Strymon River on the Strymonic Gulf had dockyards for ship building,[75] evidence of accessible timber. But it must be remembered that this river drains an extensive highland region, which, owing to its elevation and northern location, gets a moderate rainfall in summer.

Deciduous trees, especially timber growth like the oak, ash, beech and chestnut, were widely distributed in northern and western Greece; but on the dry eastern side of the peninsula, where the rainfall rarely exceeds 25 inches, and in many localities falls far below, these trees were generally restricted to the mountains. The chestnut tree, still found in groves on Mount Olympus and the Pindus range, grows in Hellas at altitudes of 2,000 to 4,000 feet (600-1,300 mm.), but declines in size and abundance farther south. Theophrastus calls the sweet chestnut (*Castanea vesca*) the "Euboean nut." It grew on the Mysian Olympus and the Tmolus range of Lydia, whence it was called "the nut of Sardis," but was more abundant on the mountains of Euboea and the Magnesian Peninsula of Thessaly.[76] Near the foot of Mount Pelion, which still has its chestnut trees,[77] was located the Magnesian seaport of Castanea, mentioned by Herodotus and Strabo.[78] Thence probably the nutritious nuts were shipped to the large Greek cities, and took their name from the place of export, like the modern Brazilian nut. Today the best chestnuts are brought to Athens from the mountains of western Crete, where an altitude of 7,500 feet or more compensates for the southern latitude. This island, owing to its mountainous relief and its exposure to rain-bearing winds, was well wooded in ancient times[79] and supported a variety of trees, especially cypress[80] and cedar.[81] These helped to maintain the navies of King Minos and the fleets of the Cretan pirates, and met a steady demand for architectural purposes both in Athens and Rome. The finest and most abundant tree was the cypress, which grew very tall on the Cretan

---

73 Theophrastus, *Hist. Plant.*, Bk. iv, ch. v.
74 Mommsen, History of Rome, vol. ii, pp. 358, 364. New York, 1872.
75 Strabo, Fragments, 33, 36.
76 Theophrastus, *Hist. Plant.*, Bk. iv, ch. v, 4.
77 Leake, Travels in Northern Greece, vol. iv, p. 393. London, 1835.
78 Herodotus, vii, 183, 188. Strabo, Bk. ix, ch. v, 22.
79 Strabo, Bk. x, ch. iv, 4.
80 Theophrastus, *Hist. Plant.*, Bk. iii, ch. i, 6; ch. ii, 6; ch. iii, 3, 4.
81 Vitruvius, Bk. ii, ch. ix, 13.

mountains. It yielded a superior building and cabinet wood almost proof against decay.

Oak and beech groves were widely distributed over the mountains of Greece, and furnished mast for large herds of wild and domestic pigs. Oaks especially grew on Mt. Olympus and Pelion. They covered the low Calledromus range of eastern Locris[82] and Mt. Ptous in Boeotia.[83] They flourished on the Arcadian highlands and covered the heights of the Parnon range on the boundary between Argolis and Laconia.[84] The Laconian side of the high Taygetus Mountains, especially about the peak of Taletum, had forests in the second century A. D.[85] which were presumably fir and vallona oak groves such as Leake found there nearly a century ago.[86] The Taygetus Mountains now turn a bare rocky front to the Eurotas valley, except where the gulches retain soil and moisture. But the slopes, now washed bare of their humus or converted into terraced vineyards, were once mantled in oak trees which Theophrastus found characteristic of Laconia.[87] The modern traveler who motors from Sparta to Tegea in Arcadia, across the mountains forming the northern boundary of Laconia, finds these highlands (pass at 3,065 feet or 940 meters) covered with a poor oak brush, preyed upon by goats, which represents the degenerate successor of the pristine oak forests.

Western Peloponnesus presents even today a pleasant contrast to the bald eastern escarpment of Arcadia, which is located in the rain shadow of the central highland. The half of Greece lying west of the mountain backbone of the peninsula, formed by the Taygetus, Arcadian, Corax, Tymphrestus and Pindus ranges, has 30 inches (750 mm.) or more of rain a year. From the Gulf of Ambracia (Gulf of Arta) northward, the broad belt of coastal highlands is yet better supplied, and gets over 40 inches (1,000 mm.) annually; moreover, it receives slight summer showers to revive its vegetation, and these increase in frequency from Illyria northward.[88]

This western front of classical Greece had sufficient rainfall to maintain considerable forests, remnants of which still survive the depredation of the goats, where located far from human habitations. In ancient times even the plain of Elis had its oak groves and woods of wild pine.[89] Forests large enough to harbor abundant deer, wild boar

[82] Herodotus, vii, 218.
[83] Pausanas, Bk. ix, ch. xxiii, 4.
[84] Ibid. Bk. viii, ch. xi, 1; ch. xii, 1; ch. liv, 5. Bk. iii, ch. xi, 6.
[85] Ibid. Bk. iii, ch. xx, 4.
[86] Leake, Travels in the Morea, vol. i, pp. 128, 132, 251. London, 1830.
[87] Theophrastus, *Hist. Plant.*, Bk. iii, ch. xvi, 3.
[88] Philippson, *Das Mittelmeergebiet*, p. 121, maps iii, iv. Leipzig, 1907.
[89] Pausanias, Bk. v, ch. vi, 4.

and antelope covered the low hill country near Olympia and the higher Phoeloe Plateau,[90] which defined the boundary between Elis and Arcadia. There Xenophon and his sons used to range the forests for game before the crowds assembled for the Olympic Games.[91] The towering peaks of western Arcadia, which overlook the Elian plains, were well forested in ancient times. Mount Lycaeus was mantled in maples and oaks, and therefore was sacred to Zeus.[92] On Mount Erymanthus was staged the famous boar hunt of Hercules, which bears witness to mast groves of beech and oak. These trees grow on its slopes today, interspersed with planes; and in spring their tender green makes a background for the white blossoms of the wild pear tree.[93]

The northern flank of mighty Erymanthus belongs to Achaia, which today has the amplest forests of oaks and conifers to be found in all the Peloponnesus, and in ancient times must have been even more abundantly supplied.[94] The ancient province occupied the northern and northwestern escarpment of the Arcadian plateau, and sloped down from a succession of lofty peaks like Erymanthus (modern Olonos, altitude 7,300 feet or 2,225 meters), Panachaicus (Voidhia, 6,320 feet or 1,927 meters), Aroanio (Khelmos, 7,724 feet or 2,355 meters) and Cyllene (Ziria, 7,790 feet or 2,375 meters). These mountains today have oak woods on their middle zone and fir forests on their upper reaches,[95] owing to the rain-bearing winds that sweep through the Gulf of Corinth. In ancient times they undoubtedly furnished convenient supplies of timber to the shipyards of Corinth and Sicyon, because they offered a choice of cedar,[96] fir and oak.[97]

Across the Corinthian Gulf the mountainous coasts of western Hellas still have scattered woodlands which bear testimony to ancient forests. Parnassus, towering to the height of 8,070 feet (2,460 meters) behind the Crissaean Bay, has beautiful pine woods at 3,000 feet elevation; and its western slope is covered with a thriving, young growth of beech, oak, and conifers, through which the modern automobile road runs from Delphi north to Gravia. Groves of cypress and pine near Oeanthia in Locris in ancient times faced the Gulf of Corinth from this northern shore.[98] Naupactus, the important seaport and naval station of this coast, lay only ten miles from the Evenus River (modern Phidari) of Aetolia, whose valley was clothed in oak forests when Leake

[90] Strabo, Bk. viii, ch. iii, 32.
[91] Xenophon, Anabasis, Bk. v, ch. iii, 9-12.
[92] Pausanias, Bk. ix, ch. xxiii, 4.
[93] Leake, Travels in the Morea, vol. ii, p. 232. London, 1830.
[94] Pausanias, Bk. vii, ch. xxvi, 10.
[95] Leake, Travels in the Morea, vol. ii, pp. 112-117. London, 1830.
[96] Theophrastus, *Hist. Plant.*, Bk. iii, ch. ii. 5. Bk. iv, ch. i, 2.
[97] Pausanias, Bk. vii, ch. xxvi, 10.
[98] Pausanias, Bk. x, ch. xxxviii, 9.

visited it a century ago.[99] This stream flows out to sea between mountains over three thousand feet high, and reaches the coast between the sites of Homeric Calydon and the ancient Corinthian colony of Chalcis.[100] It doubtless brought down wood to build the Calydonian fleet which sailed for the Trojan War, and centuries later, ship timber to be exported to the treeless city of Corinth. All the mountains fronting this north coast of the Gulf of Patras were well wooded on their upper slopes a century ago, though cleared for cultivation below. Oak trees growing there were big enough to furnish the dug-out boats used in the navigation of the shallow Lagoon of Mesolongion between the mouth of the Evenus and the Achelous (Aspropotamo).[101] The Achelous River opened up the well-wooded mountains of Acarnania, which faced the rain-bearing winds from the west.

To the forests of the Ionian Islands Homer himself bears witness. He was familiar with "wooded Zacynthus," the tree-grown slopes of showery Ithaca, and the wind-swept woods of Neritus.[102] Abundant timber was one factor in the nautical development of all these western islands and coastlands from Zacynthus north to Epidamnus (Dyrrachinin or Durazzo) on the Illyrian seaboard. Moreover, the numerous colonies planted by Corinth on these coasts in Corcyra (Corfu) Ambracia, Leucas and Epidamnus[103] suggest that the mother city, poorly provided with wood, wished to assure her supply of ship timber for her big navy and merchant marine from these western sources. From these she could not easily be cut off by great commercial rivals like Aegina, Euboean Chilcis, and Athens, which lay on the Aegean side of the Isthmus, while Corinth could import the western lumber through her port of Lechaeum on the Gulf of Corinth.

The mountains surrounding the Gulf of Ambracia (Arta) a hundred years ago still abounded in large oaks and conifers well suited to naval construction. In 1788 and for seven years thereafter ship timber from these slopes was regularly exported from Prevesa to the French navy-yard at Toulon.[104] When Augustus Caesar planted the important naval base of Nicopolis at the entrance of the Gulf of Ambracia,[105] he chose the location with remarkable insight. This big inlet marked the southern border of Epirus and of the area of heavy rainfall with occasional summer showers, which characterized the Adriatic front of

[99] Leake, Travels in Northern Greece, vol. i, p. 108. London, 1835.
[100] Thucydides, i, 108.
[101] Leake, Travels in Northern Greece, vol. i, pp. 113-114. London, 1835.
[102] Iliad, ii, 361, 632. Odyssey, i, 246; xiii, 243-6; xiv, 1-2.
[103] Thucydides, i, 24, 30, 80.
[104] Leake, Travels in Northern Greece, vol. i, 163-6, 172, 181-2; vol. iv, 47-50. London, 1835.
[105] Strabo, Bk. vii, ch. vii, 5-6.

the Balkan Peninsula.[106] The forests of western Hellas culminated in the mountains of Epirus. There the famous oak grove of Dodona formed the earliest sanctuary of Zeus, the Thunderer. Beyond Epirus lay the rainy coasts of Illyria and Dalmatia, whose forests supplied the pirate fleets infesting these shores from ancient times.

According to the evidence, the crying need of eastern Mediterranean lands was for ship timber. A multitude of fishing smacks, naval vessels, merchant ships, and coastwise transportation boats kept up the demand for fir, pine, cedar and minor woods which entered into their construction. The coniferous forests were therefore constantly levied upon; and they were further depleted by the steady demand for pitch, tar and resin. Traffic in these usually accompanied the lumber trade, and emanated from the same sources of supply. Pitch and tar were doubtless procured from pine and fir trees in all parts of Greece, but the chief output came from the Caucasus, Phrygian Ida, and Macedonia, especially from the extensive coniferous forests on the northern slopes of Mt. Olympus and Mt. Pierus in southern Macedonia.[107] In Syria pitch was distilled from terebinth and Phoenician cedar,[108] and was exported thence to Egypt, where it was used, among other things, for treating the surface of the bulrush boats.[109]

The demand for all products of resinous woods was relatively greater in antiquity than now. They were employed for the preservation of ship wood and all ship equipments, for coating the interior of earthenware wine jars, and for the preparation of volatile oils, salves and ointments, which were almost universally used in ancient times. Resin and tar were the chief basis of cough medicines prepared by Greek physicians, and were ingredients of salves for external use. Oil of cedar, distilled from the Syrian cedar, was regularly used for these purposes, because its antiseptic or cleansing qualities were recognized.[110] It was exported from Phoenicia to Egypt where it was needed for embalming the dead.[111] The Romans used it for soaking wood as a protection against decay and insect attack.[112] This was the ancient forerunner of the modern creosoting process.

The Western Mediterranean Basin, owing to more ample and protracted rains, was fairly well supplied with timber in nearly all its

106 F. Trzebitsky, *opus cit.*, pp. 186-7.

107 Vergil, Georgic III, 450. Pliny, *Hist. Nat.* xiv, 20. Theophrastus, *Hist. Plant.*, Bk. ix, ch. ii, 3-4; ch. iii, 1-4.

108 Theophrastus, *Hist. Plant.*, Bk. ix, ch. ii, 2, 3. Bk. iv, ch. vi, 1. Bk. iii, ch. xv, 4.

109 Exodus, ii, 3.

110 Naumann and Partsch, *Physikalische Geographie Griechenlands*, pp. 376-7. Breslau, 1885.

111 Herodotus, ii, 87. Pliny, *Hist. Nat.*, xvi, 11.

112 Vitruvius, *De Architectura*, ii, 9.

parts. This was true even of its African coast, because the high Atlas ranges tracing this littoral extract rain from the prevailing north winds. Hence they supported forests of big trees in ancient times.[113] The woods on the mountainous Rif coast of western Mauretania in places came down close to the sea, and clothed the promontory of Mt. Abila at the Strait of Gibraltar with a mantle of great trees.[114] These doubtless furnished timber for the ships of the Rif pirates who for two thousand years sallied out from that rugged littoral. The highest peak of the western Rif range, the modern Beni-Hassan, rises to an altitude of 7,216 feet or 2,200 meters, and lies only about twelve miles from the sea so that its timber was readily accessible. Farther east, in Algeria (ancient Mauretania Caesariensis and Numidia) the rainfall varies along the coast ranges from 24 to 32 inches (600 to 800 mm.), but exceeds this maximum in the great highlands of the Grand and Little Kabyle (ancient Byrinus Mons) where peaks towering to 7,000 feet or more get 60 inches (1,500 mm.).[115] This was essentially the region of the famous *Atlantis silva,*[116] or forests of a tree known to the Romans as the *citrus,* but quite distinct from the *citrus Medica* or citron. The tree was nearly related to the cypress, and yielded a beautifully variegated wood, which was imported into Italy for the manufacture of fine furniture and coffered ceilings.[117] Pliny identifies it with the thyou or thuya tree of the Greeks, which is still a product of Moroccan and Algerian forests, and is used by the Turks in their mosques as the choicest material for ceilings and floors. Among the ancient Romans the wood was highly prized and very costly. Tables of it sometimes measured four and a half feet in diameter, and sold in Cicero's time, before the days of degenerate luxury, for a million sesterces or twenty thousand dollars.[118] Martial reflects the popular estimate of the wood when he writes:

> Accipe felices, Atlantica munera, silvas:
> Aurea qui dederit dona, minora dabit.[119]

Some commentators identify this *citrus* with the *cedrus* or cedar tree of the Atlas Mountains, which Pliny rated as high as the cedars of Lebanon.[120] Vitruvius, who was an authority on architectural materials, made the same estimate of this wood. It was abundant in ancient as in modern times, and was exported to Rome. Beams of Numidian

113 Pliny, *Hist. Nat.*, v, 1.
114 Strabo, Bk. xvii, ch. iii, 4, 6.
115 Vidal-la-Blache, Atlas, map 2, p. 79. Paris, 1906.
116 Lucullus, x, 144.
117 Horace, *Carmina*, Bk. iv, 1, 20.
118 Strabo, Bk. xvii, ch. iii, 4. Pliny, *Hist. Nat.*, xiii, 15. Lucanus, ix, 416.
119 Martialis, xiv, Ep. 89.
120 Pliny, *Hist. Nat.*, xvi, 39.

cedar used in the construction of the Temple of Apollo at Utica[121] when the city was founded undoubtedly came from these forests. We must look to the same source for the ship timber which for centuries built the Carthagenian fleets.[122] Cork and tanners' bark have through the ages contributed to the trade of Saldae (Bougie) and Hippo Regius (Boné).

Owing to the more general distribution of forests in the Western Mediterranean Basin, the lumber trade seems never to have reached the development which it attained in the Levantine and Aegean Seas. In the days of Rome's splendor it brought building materials and choice cabinet woods from various regions to the rich and growing capital, and furnished ship supplies for the maintenance of the navy. Italy itself included the districts of heaviest rainfall and therefore of the best forests of ship timber, but certain other ship supplies, such as tar, pitch and wax, were economically produced elsewhere. Their bulk was small in relation to their value; so transportation charges were an almost negligible element in their market price.

Pitch was a regular article of commerce, procured from regions of ample coniferous forests; it was usually coupled with ship timber, resin, honey and wax. The Sila Mountains of the southern Apennines, today as in ancient times an important lumber region,[123] produced the famous Bruttium pitch of the Roman world.[124] This was evidently exported through the harbor of Narycium, the old Greek Epizephyrii, for Vergil couples the pitch-yielding forests with that city.[125] Gades (Cadiz) in southern Spain used the local ship timber for her own merchant marine, but supplied to Mediterranean commerce pitch, honey, wax and quantities of kermes berries or cochineal,[126] which point to oak forests. Cadiz and its vicinity get about 30 inches (750 mm.) of rain a year; but to the east rises the great Sierra de Volox with a peak 6,530 feet (1,960 m.), and from this range ample forest products were doubtless obtained. The still higher Sierra Nevada, culminating in the peak of Mulhaden (11,418 feet or 3,481 meters), and the northeastern extension of these highlands in the Sierra de Segura, rising in the Sierra Sagra to 7,872 feet (2,400 meters), were called by Strabo the mountain chain of the Bastetani, and described as thickly wooded with gigantic trees.[127] This was probably an exag-

[121] Ibid., xvi, 40.

[122] E. Speck, *Handelsgeschichte des Altertums*, vol. iii, Part I, ¶ 522. Leipzig, 1905.

[123] Pliny, *Hist. Nat.*, iii, 5. W. Deecke, Italy, pp. 428-430. London, 1904.

[124] Strabo, Bk. vi, ch. i, 9. Pliny, *Hist. Nat.*, xv, 7.

[125] Vergil, Georgic II, 438.

[126] Strabo, Bk. iii, ch. ii. 6.

[127] Strabo, Bk. iii, ch. iv, 2.

geration in view of the moderate rainfall of 20 to 30 inches, but the forests were ample enough to supply the Phoenician coast colonies of Malaca (Malaga), Maenaca, and Abdera. New Carthage probably drew the ship supplies for its busy port from Sierra Sagra by way of the Tader River (Segura), which rises on these high slopes. All the eastern Spanish littoral, except the Pyrenean coast, has a rainfall of 16 inches or less (400 mm. or less),[128] and therefore was compelled to import its timber from the mountains or from overseas. The juniper beams in the temple of Diana at Saguntum were said to have been brought by the original Greek colonists from Zacynthus.[129]

Southern Sicily has a meager rainfall, but Aetna and the mountains along the northern coast get sufficient precipitation for moderate forests. Early Greek legend represented it as well wooded, abounding in stately oak groves and open forest glades where cattle pastured.[130] Odysseus found this island of the Cyclops covered with trees, among them " tall pines and crested oaks."[131] Evidence of local ship timber is found in the big fleets maintained for centuries by the tyrants of Syracuse and other Sicilian cities. These enterprising rulers doubtless drew their main supply from the ample forests of Aetna;[132] and they may also have tapped the resources of the Sila Mountains across the Strait of Messina, in those periods when Syracuse extended .its control over Bruttium.

Italy was the chief seat of the lumber trade in the Western Mediterranean, owing to the considerable rainfall (30 to 40 inches or more) on the Alps and Apennines. The eastern littoral, lying in the rain shadow of the Apennines, was poorly provided with timber; but the western and northern plains, even near sea level, had a goodly covering of forests as late as the end of the fourth century B. C. Both the hills and plains of Latium were well supplied with timber. Pliny and Livy mention numerous ancient woodlands in the vicinity of Rome.[133] Theophrastus considers Italy one of the important sources of ship timber accessible from the Mediterranean.[134] He praises the fir and pine of Latium, but finds them excelled by the tall coniferous forests of Corsica. He mentions the fine beech groves of the Latin plain from which the Etruscans got very long planks for the keels of their

---

[128] Philippson, *Das Mittelmeergebiet*, p. 119, map iii. Leipzig, 1907.
[129] Pliny, *Hist. Nat.*, xvi, 40.
[130] Diodorus Siculus, iv, 5.
[131] Odyssey, ix, 112-113, 186.
[132] Strabo, Bk. vi, ch. ii, 8.
[133] Livy, *Historia Romae*, i, 30, 33; ii, 7. Pliny, *Hist. Nat.*, xvi, 10, 15.
[134] Theophrastus, *Hist. Plant.*, Bk. iv, ch. v, 5.

ships, and comments on the abundant growth of oak, laurel and myrtle on the promontory of Circei.[135]

Hence during Italy's early centuries of retarded economic development, when she furnished only raw materials to commerce, one of her chief items of export was ship timber.[136] It is probable that firs and other woods from the northern Apennines figured in the early commercial dealings of the Etruscans with the Carthaginians, for the domestic timber of the latter was comparatively limited in variety. Greece, as we have seen, probably drew upon Italian lumber, both from the mainland and from Corsica. The forests of Corsica reached down to the shore; they were therefore readily accessible and made the island an object of conquest. At some very early date timber was cut there by the Romans, and conveyed away on rafts provided with sails. One of these was broken up by a storm and lost.[137] It was probably these wooded shores of Corsica which gave the island a high repute far away on the Ionian coast of Asia Minor, and which induced the ancient colonists from Phocaea to settle there. The Etruscans expelled the strangers from this choice forest reserve, and for centuries after exacted a tribute of pitch, honey and wax from the island.[138] Later the Romans exploited its fine boxwood, for box trees grew there to extraordinary height.[139] The familiarity of Theophrastus with this particular Corsican product[140] suggests that it was imported into Greece, where the hard, close-grained wood was used in carving images of the gods.[141]

The early Etruscans sought timber far afield because of some peculiar fitness for their purposes, like the long beech logs of Latium,[142] or because of its superior accessibility. They had ample wood at home, owing to the northern location of their district and its numerous mountain ranges. The Ciminian forest covering the hill range of Mt. Ciminius in southern Etruria was, in 310 B. C., considered as frightful and impassable by the Roman army as were the vast German forests centuries later. Not even a trader with his pack mule dared to traverse it.[143] In the Second Punic War a fleet of thirty ships was contributed by the Etruscan cities to the navy of Rome. The timber was donated by Volaterrae, Clusium and Perusia, all located in the hills of Etruria, and Rusellae on the coast, which commanded the fir

135 Ibid. Bk. v, ch. viii, 1-3.
136 Mommsen, History of Rome, vol. ii, p. 255. New York, 1906.
137 Theophrastus, *Hist. Plant.*, Bk. v, ch. viii, 2.
138 Diodorus Siculus, v 13.
139 Ibid, v, 1. *Pliny, Hist. Nat.*, xvi, 16.
140 Theophrastus, *Hist. Plant.*, Bk. iii, ch. xv, 5.
141 Ibid. Bk. v, ch. iii, 1, 7.
142 Ibid. Bk. v, ch. viii, 3.
143 Livy, *Hist. Romae*, ix, 35-36.

forests of the Umbria River basin.[144] The Tiber river with the tributary Clanis, Tinia, Nar and Anio, tapped the Apennine forests of Etruria, Umbria, and the high Abruzzi Plateau of the Sabine country, and brought thence the immense supplies of lumber required by the growing capital of Rome.[145] From these sources came the longest and straightest planks used in Rome to build its villas, palaces and temples during the time of Augustus.[146]

Where the Apennines bend westward and trace the Ligurian coast, they get over 50 inches of rain a year. Their rain-drenched slopes were therefore covered with dense forests in ancient times. Trees grew there to immense height and sometimes measured eight feet in diameter. Much of the wood was very superior, beautifully veined, and equal to cedar for cabinet work. This, together with excellent ship timber, was exported through the port of Genoa.[147] The Roman naval base of Luna, located in a deep bay (Bay of Spezia) on the southern edge of the Ligurian Apennines, undoubtedly drew thence its abundant ship supplies. This choice timber of the northern Apennines had once been employed in constructing the vessels of the Etruscan pirates; later it built the triremes of ancient Pisa for her long wars against the Ligurian pirates,[148] and later still the growing fleets of Rome. In the Middle Ages it equipped the merchant marine and navy of both the Pisan and Genoese Republics, when competing for the trade of the Mediterranean and fighting Saracen pirates.

Northern Italy had abundant timber also on the Alpine slopes and in the Po valley, but these supplies were in general too remote from the big centers of population in the south for the export of crude lumber, unless in response to a special demand. Larch trees which were found only in this northern district and which furnished very long, straight timbers, were transported from the Alpine valleys by the Po River to Ravenna, and from there were distributed along the neighboring coasts as far south as Ancona; but they could not stand the costly haul to Rome.[149] However, Tiberius Caesar, needing long beams for the construction of a bridge over his *naumachia,* ordered larch trees to be cut on the Rhaetian Alps and brought to Rome. One of these large logs was 120 feet long.[150] The finest bird's eye or " peacock " maple to be found anywhere came from the Rhaetian Alps and the hill ranges of the Istrian peninsula. It ranked with the famous

144 Ibid. xviii, 45.

145 Strabo, Bk. v, ch. ii, 5; ch. iii, 7.

146 Strabo, Bk. v, ch. ii, 5.

147 Strabo, Bk. iv, ch. vi, 2.

148 Strabo, Bk. v, ch. ii, 5.

149 Vitruvius, *De Architectura*, Bk. ii, ch. ix, 14-17.

150 Pliny, *Hist. Nat.*, xvi, 39-40.

citrus wood in point of beauty, and was so valuable for cabinet work[151] that it could bear the heavy transportation charges to distant Rome.

Ship timber from the eastern Alps was undoubtedly floated down to the Adriatic in very early times to build the Etruscan merchant ships at Adria and Spina, and later to equip the transport and naval vessels of the Romans in the ports of Aquileia and Pola. On a larger scale, however, forest products of small bulk, such as resin, pitch, honey and wax, were contributed by the tribes of the eastern Alps to Mediterranean commerce in exchange for food stuffs, and were shipped from Aquileia and other Adriatic ports.[152] Fine resin used in medicine came from the foothills of the Italian Alps.[153] Cisalpine Gaul had extensive pitch works, and manufactured huge wooden wine casks lined with pitch, which aroused the admiration of Strabo.[154] This cooperage business was coupled with an active and long established pork-packing industry, for the abundant mast in the oak, beech and chestnut groves of the Po valley supported large herds of swine.[155]

The Mediterranean coast of Transalpine Gaul and its Rhone valley hinterland, owing to its northern location, had ample forests. These furnished timber for the rafts and dugout boats which forwarded native traffic on the river;[156] and also equipped the merchant marine of the Greek traders of Massilia from the sixth century B. C.[157] An ancient export trade in ham and bacon from the Rhone valley to Rome indicates mast groves in this district, while a similar trade from the eastern Pyrenees points to forests there.[158] The conifers of the Pyrenean hinterland of the Mediterranean, nourished by a rainfall of 30 inches (750 mm.) or more, undoubtedly maintained the merchant fleets of the ancient Greek colonies of Emporiae and Rhoda, western outposts of the Massiliot settlements, while the woods of the Maritime Alps equipped the ships of the eastern outposts, Antipolis, Nicaea, and Portus Monoeci, as likewise of the native pirates, who raided Massilian commerce.

All this northern timber belt of the western Mediterranean lies within the limits of the middle-European forests. In ancient times it produced finer, more varied and abundant timber than was generally to be found in the southern districts. Moreover, the stretch from the Pyrenees to the Julian Alps long remained a colonial frontier of Rome, and hence served as a forest reserve after all the good timber of Latium

151 Ibid, xvi, 15.
152 Strabo, Bk. iv, ch. vi, 9-10; Bk. v, ch. i, 8.
153 Pliny, *Hist. Nat.*, xvi, 11.
154 Strabo, Bk. v, ch. i, 12.
155 Polybius, ii, 15. Varro, *Rerum Rusticarum*, ii, 4.
156 Polybius, iii, 42. Livy, *Hist. Romae*, xxi, 26.
157 Strabo, Bk. iv, ch. i, 5.
158 Strabo, Bk. iii, ch. iv, 11.

and other densely populated districts of the Peninsula had been exhausted.

The denudation of the Mediterranean forests progressed rapidly in antiquity, especially in the Eastern Basin, which in the beginning was more scantily provided with timber and developed big centers of population and advanced civilization earlier than the Western Basin. Therefore its supply was small and the demand was great. Plato, in the fifth century B. C., deplores the reckless destruction of the forests and the consequent failure of springs and streams in Greece, owing to the rapid run-off of the rain from the bared hillsides. He also indicates that the Greeks for a long time had been turning their attention to raising forest trees by cultivation,[159] probably in an effort to maintain a local supply of timber for minor local needs. A century later Theophrastus complained that the supply of ship timber in the Eastern Basin was very limited, and that only the forests of Macedonia and Thrace remained fairly abundant.[160] In the same period the cedar groves of Cyprus were retreating from the coasts into the mountain interior of the island, though the woods of the Lebanon range still survived, owing to the elevation and westward exposure of the mountains. One is led to surmise also that those expert Phoenician woodsmen, who were commended by King Solomon, may have understood the fundamental principles of forestry and therefore have intelligently exploited their timber supplies. The small copses and meager woodlands of ancient Palestine were unable to stand the onslaughts of civilization. Therefore for Abraham and other ancient sheiks it was an act of merit to plant even a solitary tree by a pool or spring.[161] The Jews cultivated walnut and fig trees for the wood as well as for the fruit.[162] They regarded the destruction of their groves by fire as a visitation from on high,[163] and the wanton destruction of fruit trees in war as a heinous offense.[164]

In the Western Mediterranean, the recession of the forests became very apparent, but at a later date. Though the lumber trade of Italy was active enough to supply the large demand, ancient Roman farmers, as indicated by Cato's treatise on Agriculture, early began to raise plantations of various trees on their estates by irrigation, and thus supply their immediate needs for timber by local production. Under the Empire arboriculture was practiced on all Roman farms, as indicated by the instructions of Vergil, Varro, Columella and Pliny. The

---

159 Plato, Critias, ch. v, p. 418. Trans. by Henry Davis. London, 1870.

160 Theophrastus, *Hist. Plant.*, Bk. iv, ch. v, 5.

161 Genesis, xxi, 33.

162 G. Adam Smith Historical Geography of the Holy Land, pp. 80-81. N. Y. 1897.

163 Isaiah, x, 18-19.

164 Deuteronomy, xx, 19.

steady demand for cedar for the roofs of temples and palaces and superior buildings caused a restriction of the supply, for the best trees grew only in Africa, Crete, Syria and Cilicia.[165] In Pliny's time the superb forests of this wood on Mt. Ancorarius in Hither Mauretania were already exhausted.[166] Even before this Roman lumber ships sought the far away Caucasus ports. Denudation of the forests made such inroads upon the wood supply of Italy that by the fifth century Roman architectural technique had become modified to meet the growing scarcity and increased price of wood.[167]

Clearing for tillage land and the legitimate consumption of wood as lumber and fuel were only part of the process of destruction. The long dry summers and the predominantly resinous character of Mediterranean timber made forest fires especially frequent and disastrous, while the high winds of the hot season fanned the flames. Such fires were a commonplace in ancient Palestine. Isaiah describes one in a metaphorical passage: "It shall devour the briers and thorns, and shall kindle in the thickets of the forest, and they shall mount up like the lifting up of smoke."[168] Homer knows the effect of protracted drought and strong summer winds upon such a conflagration. "Through deep glens rageth fierce fire on some parched mountain side and the deep forest beneath, and the wind, driving it, whirleth everywhere the flame."[169] The Greeks were familiar with the spontaneous origin of such fires in the mutual attrition of branches or trees in the dry season.[170]

Fires were often started, either intentionally or accidentally, by the herdsmen who ranged the mountain forests with their flocks of sheep and goats in the dry season. Burning improved the pasturage, because the ashes temporarily enriched the soil, and the abundant shoots from the old roots furnished better fodder. The forests once destroyed were hard to restore. Goats clipped the young growth from the hillsides as with shears. Trees which depended on deep root systems for their moisture could not survive the summer drought; saplings with shallow roots could not get a start. Moreover, there was no shade to help conserve the surface moisture in soil and root, at a season when the dry atmosphere was especially pervious to the sun's light and heat.

The chemical decomposition of rocks has always proceeded slowly in Mediterranean lands, owing to the lack of sufficient moisture for abundant plant life. Mechanical disintegration has also been slow,

165 Vitruvius, *De Architectura*, Bk. ii, ch. ix, 13.

166 Pliny, *Hist. Nat.*, xiii, 15.

167 Kingsley Porter, personal communication.

168 Isaiah, ix, 18; x, 17-19.

169 Iliad, xx, 490-492. Also xi, 154-157; xxi, 340-349.

170 Thucydides, ii, 77.

owing to the lack of intense cold. Hence both weathering processes have been weak, with the result that soil has accumulated by infinitesimal degrees, and has spread in a very thin mantle over the slopes. Except in the small silted valleys the rocks lie near the surface. Alluvial plains of considerable extent are rare; plains of loess or glacial clay are wanting.[171] The rock skeletons of Mediterranean lands are everywhere prone to thrust through the meager envelope of soil.

When the mountains were denuded of their forests, the violent autumn storms with their sudden downpour of rain scoured off the thin covering of earth from the steep declivities. The shield of foliage was no longer there to break the impact of the rain; the network of roots no longer held the light humus to the slopes. A stunted thorny scrub, the *maquis,* rooted in shallow pockets of earth, succeeded the denuded forests which formerly conserved and distributed moisture in the dry season, and preserved large areas for cultivation by irrigation.[172] Under the assault of the goats, the *maquis* even has grown shorter and thinner, exposing ever larger spaces to the scouring action of rain in winter and wind in summer, till mountains have become quite bare, as in parts of Greece and Spain. In many sections of the Mediterranean a single deforestation has meant denudation of the soil also and hence, the permanent destruction of the forests.[173]

Hence all Mediterranean lands today show a low percentage of forested area, despite the predominant mountain relief which would naturally be devoted to tree growth. Spain has 20.8 per cent of her area in forests, Portugal 5.2 per cent, Italy 15.7, Greece, 9.3.[174] These are much lower percentages than are to be found in Germany, Switzerland, Norway or Japan; yet even these probably represent in part a low scrub and not genuine forests.

---

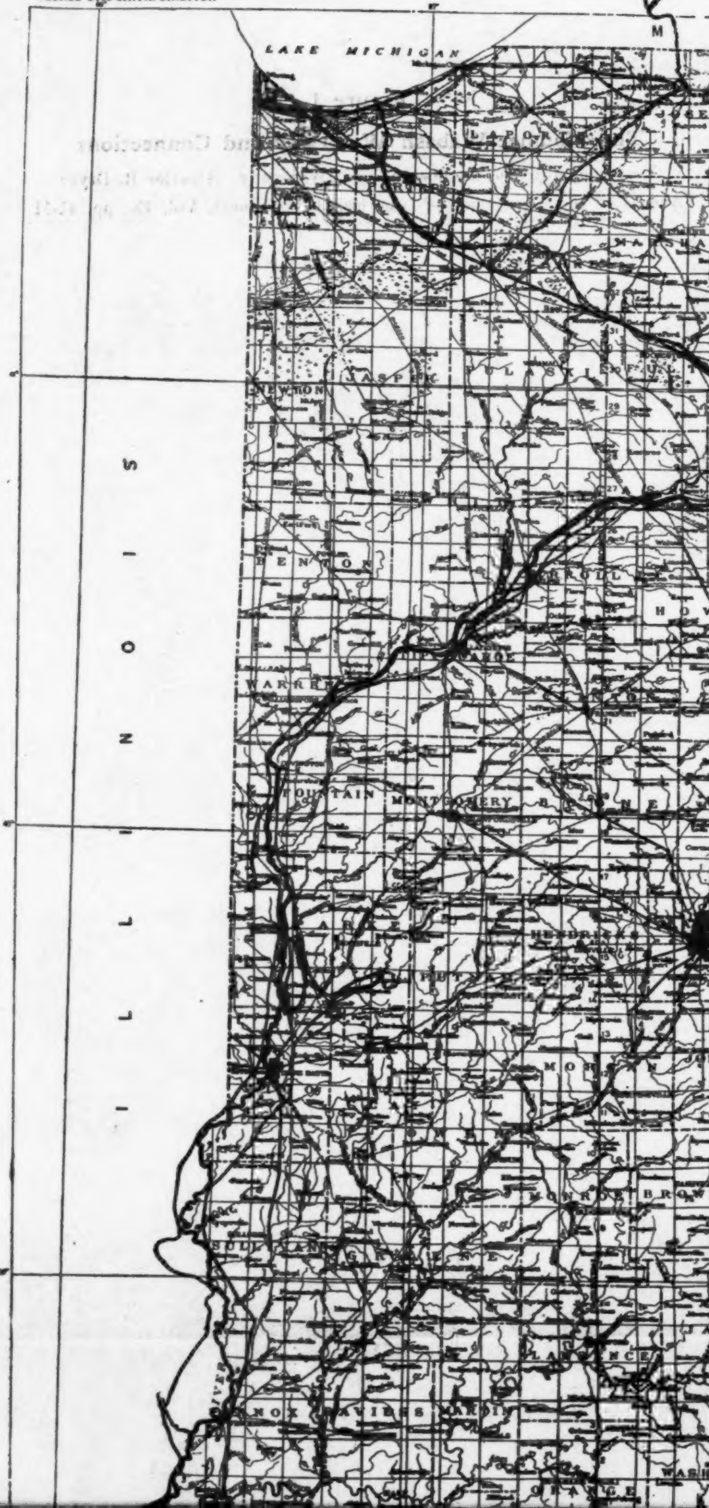
[171] Philippson, *Das Mittelmeergebeit,* pp. 142-144. Leipzig, 1907.

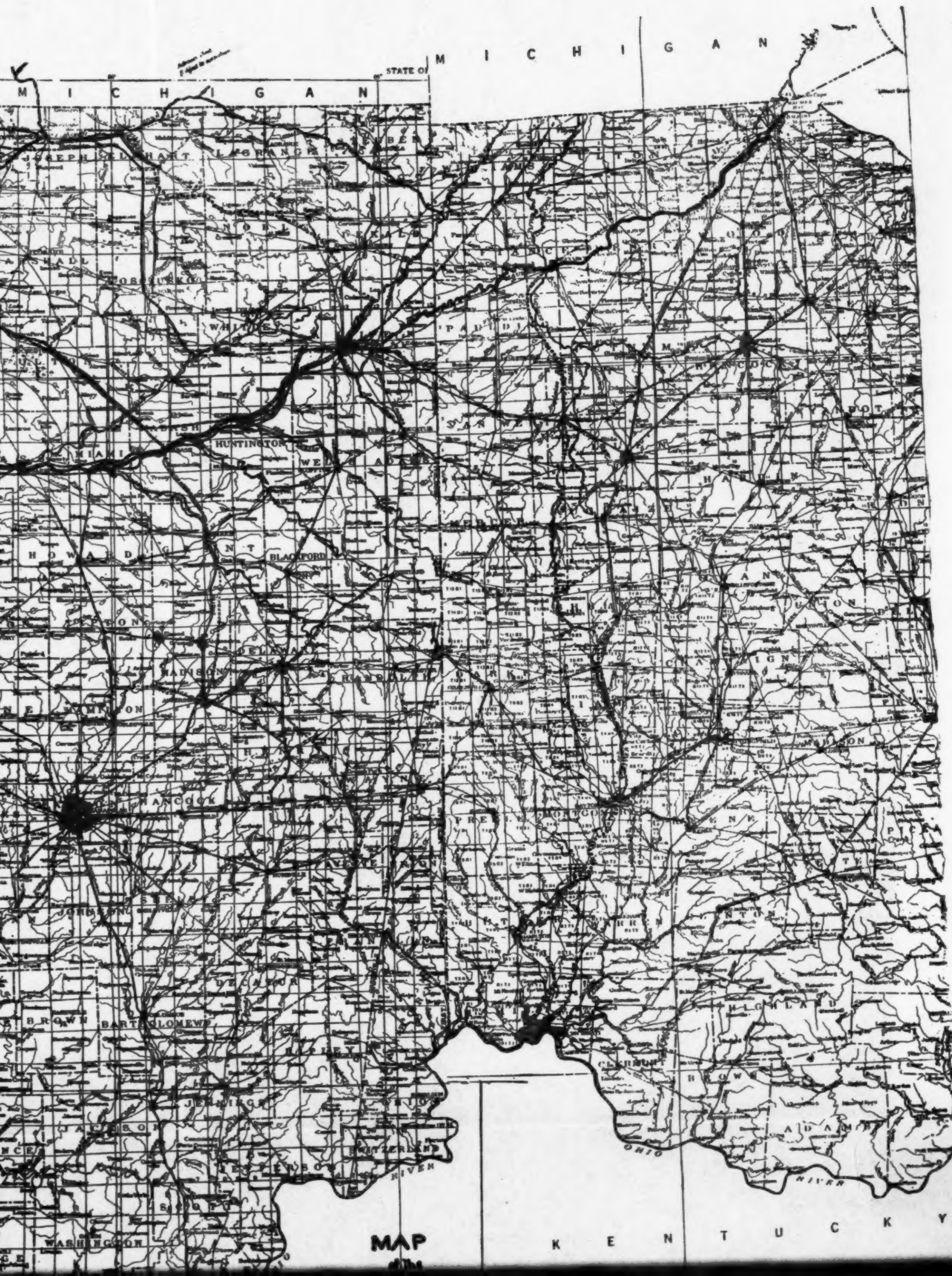
[172] M. Newbegin, Modern Geography, pp. 119-128. London 1911.

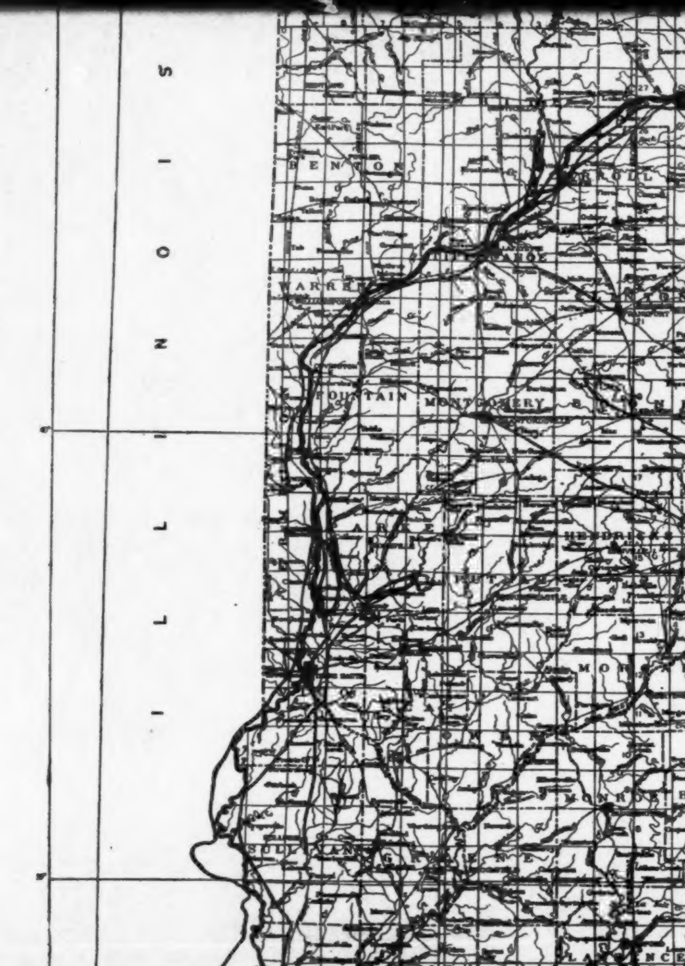
[173] Philippson, *Das Mittelmeergebeit,* p. 144. Leipzig, 1907.

[174] Ibid, p. 154.

DEPARTMENT OF THE INTERIOR
FRANKLIN K. LANE, SECRETARY
U. S. GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR




STATE OF
M I C H I G A N
M I C H I G A N
HUNTINGTON
BLACKFORD
HANCOCK
MADISON
BARTHOLOMEW
BROWN
WASHINGTON
SWITZERLAND
ADAMS
OHIO
RIVER
RIVER
K E N T U C K Y
MAP


I L L I N O I S
FOUNTAIN
MONTGOMERY
OHIO
K. E N


MAP
of the
MAUMEE-WABASH
WATERWAY
WITH CONNECTIONS
Drawn by Chas R. Dryer
1918
Stansbury Surveys
State
Millis
Taylor's Route
K E N T U C K Y
OHIO
RIVER
HUNTINGTON
BLACKFORD
HOWARD
HANCOCK
RANDOLPH
BARTHOLOMEW
BROWN
JACKSON
WASHINGTON
JEFFERSON
SWITZERLAND
HARRISON
CLERMONT
BROWN
ADAMS
MADISON

Figure 1

The Maumee-Wabash Waterway and Connections

To accompany The Maumee-Wabash Waterway. Charles R. Dryer

Annals of the Association of American Geographers, Vol. IX, pp. 41-51

Annals of the Association of American Geographers
Volume IX, pp. 41-51; with 11 figures

THE MAUMEE-WABASH WATERWAY

CHARLES REDWAY DRYER

CONTENTS

Introduction.—The most important geographical feature between the Laurentian lakes and the Ohio river is the Maumee-Wabash trough. Its geological history and its complex and, in many respects, anomalous character render it of unusual interest to the physiographer, while its relations to travel and trade attract the attention of the historian and economist.

The axis of the trough extends from Lake Erie, southwest and south 420 miles to the junction of the Wabash river with the Ohio, approximately bisecting the space between Lake Michigan and the middle Mississippi on the northwest and the Ohio on the southeast. From the Erie end, the bottom rises 177 feet in 102 miles to a flat col at Fort Wayne, Ind., 750 feet A. T.; and thence falls 439 feet in 318 miles to the Ohio end. The trough is now occupied between Toledo and Fort Wayne by the post glacial Maumee river, at the col by a marsh 12 miles long and through the remainder of its length by the Wabash river and its tributary, the Aboite. (See Fig. 1.)

Preglacial Drainage.—Whether the Maumee-Wabash trough was traversed by a Tertiary stream carrying waters from the present Erie basin to the Mississippi, as suggested by Grabau,[1] is a question which promises little prospect of settlement. Such a stream would cross the Cincinnati arch, and the drift-buried gorge which it presumably occupied has not been discovered by hundreds of borings made for oil and gas along its course. The possibilities as to the extent of the preglacial

[1] Grabau, A. W., N. Y. State Museum Bulletin No. 45, pp. 42-6.

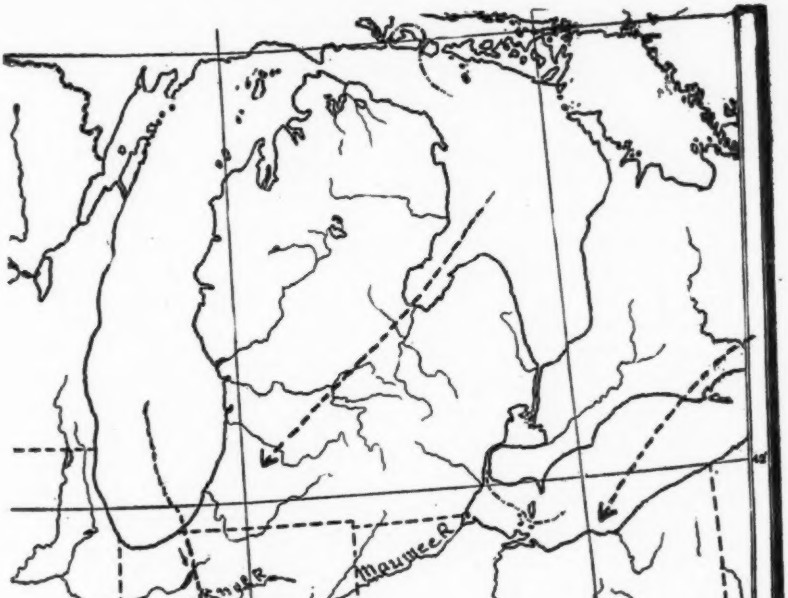
Wabash drainage system revealed by the studies of Tight,[2] Bownocker,[3] Capps,[4] Leverett[5] and others are indicated in Fig. 2.

THE WABASH TROUGH.—*The Extra-Wisconsin or Flood Plain Section.*—The Wabash river crosses the Shelbyville moraine, where it escaped from the margin of the Wisconsin ice sheet, a few miles above Terre Haute, Ind., and 135 miles above its mouth. (Figs. 3-5.) This section of the valley is cut out of Pennsylvania shales, limestones and sandstones, nearly along the strike of the strata, to a depth of 250 feet and a width of six to twelve miles. It is now about half full of glacial outwash and surficially occupied by flood plain and gravel terraces, which diminish in height from 80 feet at the upper end to 20 feet at the lower. Occasional residual buttes rise from the valley floor 100 to 150 feet to the height of the bordering bluffs.[6] At the foot of the Shelbyville moraine it is joined by the preglacial valley of Raccoon Creek, one mile wide and 200 feet deep.[7]

The Preglacial Wisconsin Section.—The Wabash valley above the Shelbyville moraine as far as Delphi, a distance of 90 miles, is cut in Mississippian shales and sandstones to a depth of 250 feet and a width of three to five miles. This trench was filled nearly to the brim with glacial outwash, which has been subsequently removed to the extent of perhaps one-fourth, leaving very massive and continuous terraces 50 to 150 feet in height. Most of this outwash seems to have been brought in through large preglacial channels, one from the north along the present course of the Tippecanoe river, and one from the east along the present course of Wildcat creek.[8] The bottom of the trough at Lafayette is only 390 feet A. T. (Figs. 6, 7.)

The Glacial Section.—The extent and volume of the preglacial Wabash above Delphi is not certainly known. Between Peru and Wabash the present trench was joined by a tributary from the southeast which may have been the trunk stream. It may be in part the work of interglacial streams. Between Delphi and Huntington, a distance of 70 miles, the Wabash trough traverses Silurian limestones, which here form the crest of the Cincinnati arch and are disturbed by local arches and cones of quaquaversal or confused dip, in some cases

[2] Tight, W. G., U. S. Geol. Survey, Professional Paper No. 13, Plate I.
[3] Bownocker, J. A., American Geologist, Vol. 23, p. 175.
[4] Capps, Stephen R., U. S. Geol. Surv. Water Supply Paper No. 254, Plate II.
[5] Leverett, Frank, Journal of Geology, Vol. 3, p. 740.
[6] U. S. Geol. Surv., Princeton Folio.
[7] Dryer, Charles R., Proceedings Indiana Academy of Science, 1912, p. 206.
[8] Leverett, Frank, U. S. Geol. Surv. Monograph LIII, p. 59.



The Preglacial Wabash and Ohio
Open Valleys
Buried
Cols

FIG. 2

of high angle, the origin of which has been the source of much controversy.[9] This section is three-fourths of a mile to three miles wide, about 80 feet deep, and characterized by numerous limestone islands and terraces. The bluffs are in part limestone and in part glacial drift, in varying alternations horizontally and vertically. At Huntington, the present upper Wabash comes in from the southeast; but it is a very young post-glacial stream and has little to do with the character of the main trough. (Fig. 8.)

The Erie-Wabash Channel or Fort Wayne Outlet.—From Huntington to New Haven, a distance of 32 miles, the trough is 1 to 2 miles wide and 50 to 80 feet deep, and is known to glacialists as the Erie-Wabash channel or Fort Wayne outlet of glacial lake Maumee. The Erie-Wabash trough above Delphi owes its origin and character to the marginal drainage of the Huron-Erie ice lobe and the Maumee outlet. As the lobe receded haltingly or rhythmically, step by step, the marginal drainage was carried by four successive pairs of tributaries which followed the ice edge 50 or 60 miles on each side of the lobar apex, and possibly contributed, each in turn, a larger volume of water than the lake outlet. Of these, the last pair, the St. Joseph-St. Marys, was the most vigorous. As soon as the glacial margin withdrew from the Fort Wayne moraine, ponded waters expanded into glacial lake Maumee and overflowed into the St. Joseph-Wabash at the point of junction with the St. Marys. In the series of rapid changes through which the Wabash drainage system passed, this condition was of relatively long duration. The marginal streams had been loaded with outwash; the lake outlet was relatively clear; hence the removal of the filling from the Wabash trough was largely the work of the Maumee outlet. (Fig. 9.)

When the lake found a lower outlet into the Saginaw basin, the upper part of the Maumee-Wabash stream was gradually reversed, the St. Joseph and St. Marys were diverted to the lake, and the old outlet channel silted up. Thus, while the very striking pattern of willowy drainage which characterizes the present Maumee river is due to capture, it was not effected by the erosion of a more vigorous stream, but by the falling level of a temporary lake and the silting up of a flat divide. The capture is hardly yet complete, since during the high water of March, 1913, the St. Marys discharged nearly one-third of its water through the old channel into the Wabash.

THE MAUMEE TROUGH.—The present Maumee river is the successor of glacial lakes Maumee, Whittlesey and Warren. From Fort Wayne

[9] Kindle, E. M., American Journal of Science, Vol. 165, p. 459.

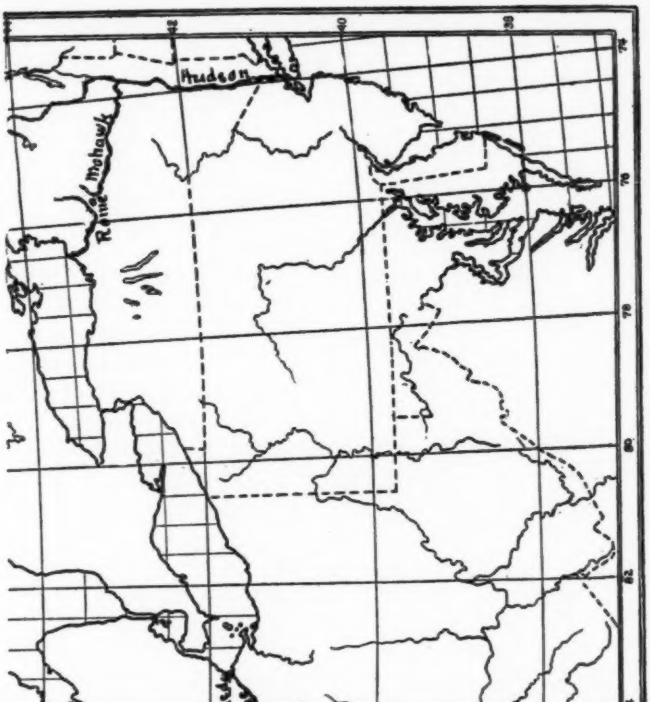

Hudson
Mohawk
Rome
Toledo
Maumee
Ft. Wayne
St. Joseph
South Bend
Kankakee
Wabash
Ohio

FIG. 10

to Defiance, O., it is sinuous and sluggish with drift bluffs and bottom. Below Defiance its bed is on or near Devonian limestones and is broken by rapids.

Summary.—The distal half of the Maumee-Wabash trough was made by a preglacial stream, comparable in age and volume with the lower Ohio. The location of its extreme headwaters is conjectural and may have been in northern Michigan, in southern Ontario, in North Carolina, or in all three. The proximal half of the trough is chiefly the product of glacial and post-glacial drainage, which extended headwards *pari passu* with the recession of the Huron-Erie ice lobe, culminating in a succession of ice-dammed lakes and was finally reversed by the eastward outflow of Lake Erie. The Maumee-Wabash trough is the correlative and homologue of the Mohawk-Hudson trough, the Fort Wayne outlet corresponding to that at Rome, N. Y., the Wabash-Ohio to the Mohawk, and the Mississippi to the Hudson. (Fig. 10.)

The Waterway.—The Maumee-Wabash trough has been for centuries an actual or potential link and trade route between the Laurentian lakes and the Mississippi and has had two periods of special prominence.

The Canoe Period.—Previous to 1783 it was a great highway for Indians and white explorers, fur traders and military forces. The French found an entrance to the heart of the continent through the back door by way of the curiously connected headwaters of the St. Joseph-Kankakee and the Maumee-Wabash. The upper lakes led them first to the shorter but more difficult route via the portage at South Bend, Ind., which La Salle followed in 1679. The maps of the seventeenth century do not show the Maumee-Wabash route, but either confound the Wabash with the Ohio or make it flow westward through central Ohio, Indiana and Illinois to the Mississippi. In 1699 D'Iberville led his colonists from Quebec to Louisiana by the Maumee-Wabash route, making it a link in the main line of communication which held the French possessions in America together. In 1720, under authority from Detroit and Quebec, a military post was established at the Wea village just below the present site at Lafayette, Ind., and called Post Ouiatenon. About the same time a French trading post was established at the Miami village at the head of the Maumee, where Fort Wayne now stands, and called Post Miamis. In 1731 Vincennes established on the lower Wabash, under the jurisdiction of Louisiana, *Au Poste,* afterwards called by his name, which remained for nearly a century the most important human center in the northwest. During the eigh-

teenth century the Maumee-Wabash canoe route reached its climax of usefulness and was followed by Indians, French and British, often in strong force. It acquired the fanciful name of "the Indian Appian Way" and the portage at its summit was called "the gateway of the west." The Miami Indians supplied carts, pack horses and carriers, sometimes at the rate of $100 a day. In 1778 Lieutenant-Governor Hamilton's British force was helped on its way to occupy Vincennes by the beavers. After the breaking of their dam had let the boats pass on a flood of water, the animals in a short time repaired it and the process was repeated. When in 1783 the territory came under the jurisdiction of the United States, the period of through canoe travel came to an end and the Maumee-Wabash waterway was little used for half a century.

After the organization of Indiana Territory in 1810 with its capital at Vincennes, all sorts of craft, canoes, pirogues, batteaux, "broadhorns" and "arks" pushed up the Wabash and its tributaries, carrying white settlers. In 1823, stern-wheel steamers began to ascend the river to Lafayette, sometimes to the number of fifty or more during the spring high water. These crafts remained important until displaced by the railroads, and are still in local use.

The Canal-boat Period.—A canal at the Fort Wayne portage is said to have been projected as early as 1804. The war of 1812-1814 demonstrated the need of transportation for military purposes and a survey was made for a canal by Captain Riley in 1818. When in the second and third decades of the nineteenth century a mania for internal improvement swept over the northwest, obvious geographical advantages attracted attention strongly to the Maumee-Wabash route. The impetus toward extensive canal construction was powerfully stimulated by the success of the Erie canal through New York. The state of Ohio began the construction of the Miami and Erie canal from Cincinnati to the Maumee at Defiance and thence to Toledo in 1825. The Wabash and Erie canal was constructed from Toledo to the Ohio-Indiana line in 1842 and the Miami and Erie canal connected with it in 1845. It is interesting to note that the latter canal has never been officially abandoned. It is still nominally open, but perhaps more useful for political than for economic purposes. Schemes for its restoration and improvement are now being actively promoted.

In Indiana, ground was broken for the Wabash and Erie canal at Fort Wayne in 1834 and three years later the summit section was opened to Huntington. The waterway from Maumee Bay to Terre Haute was complete in 1847. Along the Wabash it followed closely the foot of the bluffs and terraces, which formed the berm bank. In 1853 the canal was extended to the Ohio at Evansville, but the bell of

the locomotive had already tolled its death knell. It cost $7,300,000 and nearly bankrupted the state, but it brought half a million people from New England, New York and Pennsylvania into Indiana, shifted trade from the Mississippi and New Orleans to Lake Erie and New York, transferred the center of population and wealth from the south to the north, changed the character and connections of the commonwealth, and determined the great part which it subsequently played in the Civil War. With the abandonment of the canal, the Wabash trade route ceased to exist, except in so far as it furnished an easy grade for railroad construction, occupied, except for short intervals, as far as Terre Haute. It is worthy of note that the preglacial section below the Shelbyville moraine was not followed by the canal, which cut across country from Terre Haute to Evansville, and has been generally avoided by railroads.

THE LAKE ERIE-LAKE MICHIGAN WATERWAY.—The present epoch of agitation for waterways has given birth to a project for connecting Lake Erie and Lake Michigan by a barge or ship canal. This project involves the canalization of the Maumee river from Toledo to Fort Wayne, and the construction of a canal from Fort Wayne across country to some point near the head of Lake Michigan, preferably and ultimately Chicago. Although the history of this canal does not date back so many centuries as that of the Suez or Panama, it possesses a respectable antiquity. Indians and Frenchmen paddled, pushed and carried their canoes over the high moraine from the St. Joseph-of-the-Maumee to the St. Joseph-of-Michigan. In 1829-30 Howard Stansbury, a government engineer, subsequently of Great Salt Lake survey fame, surveyed two routes between the Maumee-Wabash trough and Lake Michigan. (Fig. 1.) The comprehensive scheme of internal improvements authorized by the Indiana legislature of 1836 provided for a canal from Fort Wayne to Michigan City, a few miles of which was actually constructed. In 1875 Major Gillespie of the U. S. Engineer Corps resurveyed and approved Stansbury's route from Lake Michigan to the Wabash at the mouth of the Tippecanoe. In 1895 Dr. William T. Harris of Defiance, Ohio, began to collect data and publicly to agitate the project for a canal from the Maumee to Michigan City by either the northern Stansbury or the Indiana improvement route. On November 16, 1907, the Toledo, Fort Wayne and Chicago Deep Waterway Association was organized at Fort Wayne with a membership of 1,000. Under its auspices Frank B. Taylor, of the U. S. Geological Survey, published a brochure, giving data, map, profile and opinions of eminent engineers on the construction of a ship canal along the Maumee-Wabash trough from Toledo to Wabash, Ind., and thence directly northwest to Chicago. Through the efforts of the

Association the Congress of the United States in July, 1912, authorized a preliminary survey of this and other routes, which was carried out in 1913-16. An elaborate, almost exhaustive, report by Col. John Millis, Corps of Engineers, was submitted to the House in August, 1917, printed and distributed in 1918.[10] (Fig. 11.)

Colonel Millis's report discusses the canalization of the Maumee river from Toledo to Fort Wayne and the construction of a canal thence to Lake Michigan by two alternative routes, neither of which follows the Stansbury or state routes. One of them is substantially the route proposed by Taylor. The topographic engineering data may be briefly stated.

The Maumee Section.—The Maumee section extends from Toledo to Fort Wayne, a distance of 109½ miles. It follows the natural river channel to be canalized by a series of dams. The rise from 570 feet A. T. at Lake Erie to 740 feet at Fort Wayne is made by nine locks, varying from 14 to 25 feet lift.

The Northern Route.—The northern route leaves the Maumee-Wabash trough at Fort Wayne and extends directly west about 30 miles, thence northerly about 40 miles, past Warsaw, Goshen and Elkhart, thence westerly past South Bend to Michigan City. The length of the section is 133 miles. Six miles from Fort Wayne the canal rises by four locks 80 feet, to a summit level 820 feet A. T. and 60 miles long, from which it descends by 10 locks, 241 feet to the Lake Michigan level. The total distance from Lake Erie to Lake Michigan is 242.5 miles. An extension parallel with the shore of Lake Michigan to Indiana Harbor, 31 miles; to Calumet Harbor, 40.5 miles; and to Chicago Harbor, 52.5 miles, would make the maximum length 295 miles.

The Southern Route.—The southern route passes through the Fort Wayne outlet 25 miles to Huntington, thence north-westerly to a junction with the northern route near Gary. The length of this section is 150 miles and the distance from Toledo to Chicago 281 miles. The canal rises by one lock of 25 feet lift at Fort Wayne to a summit level at 765 feet A. T., 83 miles long, then descends by 8 locks 186 feet to the Lake Michigan level.

Ample water supply for the summit level of either route would be furnished by numerous morainic lakes in Indiana and southern Michigan, improved by a system of reservoirs and feeders.

Of the two, the northern route is favored by the engineers, on account of fewer aqueducts and deep cuts, avoidance of rock excavation and of

[10] Millis, John, House of Rep. 65th Congress, 1st Session, Document No. 343.

waterproof embarkments across the Kankakee marshes, better water supply, service of a larger local population, including the cities of Goshen, Elkhart, Mishawaka, South Bend and Michigan City and about $1,000,000 less cost.

The type of canal contemplated corresponds to that of the New York barge canal, having a minimum bottom width of 75 feet and a minimum depth of 12 feet, with locks 45 x 328 feet. The capacity of the canal is estimated at 7,500,000 tons annually. The estimated cost is by the northern route $135,078,248, by the southern route $135,-956,195. Double locks will increase the cost about $12,000,000.

The Case for the Canal.—The principal considerations advanced by the promoters of the canal are as follows:

(1) It would form a necessary link in a continuous waterway from the Chicago district to New York, which would be practically of the same length as existing rail routes; and could be traversed by barges from end to end without trans-shipment of cargoes. This would bring about a decided lowering of freight rates.

(2) It would be about 400 miles shorter than the existing lake route by way of Mackinac.

(3) In addition to these advantages for through freight transportation, it would furnish water power and facilities for local traffic and thus promote manufacturing in a rich and populous territory of Indiana and Ohio.

(4) It would form a trunk line with which branches and feeders could be connected by way of the lower Wabash to the Mississippi, and by way of the Miami and Erie canal to the Ohio at Cincinnati.

(5) In case of war (with Canada), it would play a part similar to that of the Kiel canal in affording a protected passage for shipping.

(6) Shipping on the canal would not be exposed to loss by storms as on the Great Lakes.

The Case against the Canal.—The report of Colonel Millis is distinctly unfavorable to the project. The principal adverse considerations are as follows:

(1) The route of the canal between Fort Wayne and Lake Michigan cannot follow any important drainage lines or course favored by natural features, but must run against the grain of the country, crossing valleys, streams, divides and ridges.

(2) The initial cost of the canal is so large as to neutralize any possible advantages and to render its construction at present unjustifiable.

(3) The slower speed of canal boats as compared with lake boats renders the time of transit by canal and lake approximately equal and renders the shorter distance of little value.

(4) The cost of barges fitted to traverse Lake Erie might be so high as to require the trans-shipment of cargoes at both Toledo and Buffalo. This could be obviated by the proposed sheltered channel along the south shore of Lake Erie.

(5) The cost of carriage per ton mile would be three and one-half times that by the lake route and practically equal to that by rail.

(6) Local traffic and water power development would be of secondary and almost negligible importance.

(7) The existing natural lake route via Mackinac renders an artificial waterway unnecessary.

In a minority report of the Board of Army Engineers, Colonel Millis calls attention to events which modify the present discouraging aspects of the Michigan-Erie canal project. Water power and flood prevention developments, carried out by state and local authorities, are likely to extend up the Maumee to Fort Wayne. The rapidly increasing industrial interests of the Calumet district may demand inland water transportation from Chicago to Michigan City. When these conditions are realized, the construction by the Federal Government of a connecting link between Michigan City and Fort Wayne would "resemble somewhat the question of substituting a bridge or a tunnel for a ferry in a railway system or of building an expensive cut-off in lieu of a circuitous detour." Such a canal would form a part of "the spinal column of the transportation system of eastern North America."

Summary.—All the arguments for and against the use of artificial waterways in general apply to the Erie-Michigan canal, besides some peculiar to itself. The tonnage to be carried between its terminals is enormous and certain to increase. The demand for larger and cheaper transportation facilities is imperative. The problem of the part to be played by waterways in the future economy of the country is too complex to permit a clear view of its solution. The Erie-Michigan canal has legitimate claims to serious consideration. It would form a supplement and analogue to the New York barge canal. Its construction is feasible and free from unusual engineering difficulties. The geographical conditions are too favorable to be ignored, and perhaps in this case the saying of Geddes, "in the long run geography disposes," will come true.

NOTE.—The writer acknowledges indebtedness to Prof. Bernard H. Schockel, of the Indiana State Normal School, for invaluable assistance in fieldwork and in the preparation of the maps. The series showing the Wabash Trough was originally drawn as one continuous map, on the scale of one mile to the inch. In the process of engraving the parts have been unequally reduced. The scales are per inch approximately as follows: Figure 3, 3.5 miles, 4, 3.0 miles, 5, 4.0 miles, 6, 3.25 miles, 7 and 8, 5.0 miles, 9, 4.0 miles. The symbols used are: Flood plain and lake bottom, dotted: Alluvial terraces, circles: Limestone terraces, brick work.

WAR SERVICES OF MEMBERS OF THE ASSOCIATION OF AMERICAN GEOGRAPHERS

In compiling these records, all references to local services, such as are involved under the headings, Town Defence Committees, Loan Drives, Four Minute Men, Committee on Agricultural Production and similar titles, have been omitted.

Henryk Arctowski.

Worked for the "Inquiry" from December 8, 1917, till the middle of December, 1918.

January was in Paris. In February and March went with the Inter-Allied Commission to Poland and returned through Germany with Professor Lord.

Returned to America in May, 1919.

Preliminary Report on Poland. 106 pp., 29 maps. Prepared by Henryk Arctowski with the collaboration of E. deCzernutzki-Lazarovich-Hrebelianovich and S. J. Zowski.

Second Report on Poland. 27 pp., 3 maps, 1 table. Economic and engineering problems by Henryk Arctowski.

Third Report on Poland. 543 pp., 1 figure. Statistical data. Demography. Prepared by Henryk Arctowski with the collaboration of Sofia Bachurska and Arthur Hill.

Fourth Report on Poland. 280 pp., 13 plates, 8 maps. Statistical Data. Agriculture. Prepared by Henryk Arctowski with the collaboration of Sofia Bachurska and Wojciech Solowij.

Fifth Report on Poland. 77 pp., 4 plates. Statistical data on Bukowkna. Compiled by Henryk Arctowski with the collaboration of Wojciech Solowij and Hermine Ehlers.

Sixth Report on Poland. 346 pp., 8 plates. Discussion of statistical data. By Henryk Arctowski.

Seventh Report on Poland. 28 pp. Statistical data. Farm animals. Compiled by Henryk Arctowski with the collaboration of Wojciech Solowij.

Eighth Report on Poland. 34 pp., 2 plates. Miscellanea Polonica. Nos. 1-4. By Henryk Arctowski.

Joint Report on Poland. 30 pp. Contribution of Henryk Arctowski.

Tenth Report on Poland. 8 pp. The Four Dumas: Poles elected in the "9 Western Governments." Compiled by Henryk Arctowski.

Eleventh Report on Poland. 8 pp. Religious and linguistic data for the "9 Western Governments." Compiled by Henryk Arctowski.

Twelfth Report on Poland. 349 pp. Statistical data on Poland. Industry. Russian data, 1910. By Henryk Arctowski with the collaboration of Leon Jezioranski.

Thirteenth Report on Poland. 256 pp. Statistical data on Poland. Industry. Russian data, 1907. Compiled by Henryk Arctowski with the collaboration of Leon Jezioranski.

Fourteenth Report on Poland. 227 pp. Maps and statistical data on Poland. Industry. Austrian data, 1902. Compiled by Henryk Arctowski and Leon Jezioranski.

Wallace W. Atwood.

Appointed to the rank of captain in the R. O. T. C. Served in the training of men in map making, map reading, general surveying.

Instructor in the S. A. T. C.

Prepared geographical description of Camp Devens and vicinity which was published on the back of the special Camp Devens map by the U. S. Geological Survey.

Member of the National Research Council committee on geology.

O. E. Baker.

As head of the section of Farm Management, Department of Agriculture, entitled "Agricultural History and Geography," helped the "inquiry" and later the Commission to Negotiate Peace in the matter of providing information as to agricultural products of several foreign countries and trade in such products. Many maps were prepared showing the distribution of the principal crops and kinds of live stock in the Poland region, Austria-Hungary as it formerly existed, the Balkan area, and the former Turkish Empire, also for the former German Colonies in Africa, and some work was done on Russia and South America. Maps of trade and reports on trade in agricultural products accompanied the crop and live-stock maps.

Harlan H. Barrows.

Preparation with Professor Salisbury of a report on the "Environment of Camp Grant," for use by men in training there.

From July, 1918 to January, 1919, was Economist in charge of Country Studies, Bureau of Research, United States War Trade Board.

L. A. Bauer.

Was member of National Research Council (Division of Physical Sciences) and of several of its war committees.

Chairman of Committee of Navigation and Nautical Instruments of Council of National Defense, to advise Emergency Fleet Corporation and U. S. Shipping Board.

Directed and carried out various specific problems assigned by military and naval bureaus, and organizations.

Nels A. Bengston.

During 1917 gave special courses in Geography of Europe and in Field Mapping, University of Nebraska.

In 1918 was engaged in potash exploration work, and was later appointed expert on bread stuffs for Bureau of Research, War Trade Board. Held this position from July, 1918, to February 10, 1919.

Was then sent by the United States Department of Commerce as trade commissioner to Norway to investigate and report upon the economic situation in that country. Part of the duties were also to assist in changing from the blockade status of the war to the unrestricted trade that followed. Acted as commercial adviser to the American Minister at Christiania.

Hiram Bingham.

Air service, April, 1917-March, 1919.

Organized and directed U. S. Schools of Military Aeronautics, May-November, 1917.

Chief of Air Personnel Division, Washington, November, 1917-March, 1918.

Tours, American Expeditionary Force, April, 1918-August, 1918.

Commanding Officer Aviation Instruction Center, Issoudum, France, August-December, 1918.

Major Air Service, S. O. R. C., June, 1917.

Lieutenant Colonel, Air Service Aeronautics, October, 1917.

William Bowie.

At the time the United States entered the war, in charge of the Division of Geodesy of the United States Coast and Geodetic Survey. Immediately thereafter, got in touch with the Division of Military Mapping of the Corps of Engineers and arranged for the cooperation of the Division of Geodesy of the Coast and Geodetic Survey with the mapping forces of the Corps of Engineers.

The field work of the Division of Geodesy, after July 1, 1917, until the time the armistice was signed, was done entirely for the military authorities and consisted of control for military maps in the southern and eastern states.

In the office at Washington, the members of the Division of Geodesy made such computations as would furnish control for military maps and, besides, did a great amount of work in preparation of the pamphlets and tables on the Lambert Projection, which were used in the military maps of France and Belgium. These pamphlets and tables

were used to a very great extent by the officers of the American Army while training in this country and also in France.

August, 1917, commissioned a Major of Engineers and was assigned to the Division of Military Mapping of the Corps of Engineers. Discharged from the army on February 28, 1919.

While with the Corps of Engineers, devised a system of grid coordinates for progressive maps in the United States. As a result of the war, it was learned that it is necessary for the effective use of artillery to have a rectangular projection on military maps. No system in use in Europe would satisfactorily meet the conditions encountered in the United States where the area of the country is so great.

Prepared the specifications for the special defense maps of the United States. In the preparation of the tables, the Coast and Geodetic Survey cooperated with the Division of Military Mapping of the Corps of Engineers.

The results of the work on the grid tables have appeared as special publication No. 59, Coast and Geodetic Survey, entitled Grid System for Progressive Maps in the United States, by Major William Bowie, Chief of the Division of Geodesy, and by Mr. O. S. Adams, Geodetic Computer, both of the Coast and Geodetic Survey.

Isaiah Bowman.

Executive Officer and Geographer of the "Inquiry," an organization of about 150 persons. Under the supervision of the Department of State, this organization prepared scientific data for the peace conference. Its headquarters were at the American Geographical Society's building from November 10, 1917, to December 3, 1918.

Chief Territorial Specialist of the American Commission to Negotiate Peace and Executive Officer of the Section of Political, Territorial and Economic Intelligence, Paris, France, from December 4, 1918, to May 21, 1919.

At the personal request of President Wilson, returned to Paris on September 28, 1919, as Territorial Adviser, arriving home on December 21, 1919, with the Peace Delegation.

At various times in 1919 was the American representative on the following Peace Conference organizations:

a) Polish Commission, February-April.
b) Polish-Ukrainian Armistice Commission, April-May.
c) Jugo-Slav-Rumanian Commission, October-December.
d) Central Territorial Commission, October-December.

Alfred H. Brooks.

Chief Geologist, A. E. F., and on staff of Chief Engineer. Capt.

Engs. April, 1917; Maj. Engs. July, 1917; Lt. Col. Engs. October, 1918. Discharged from Army, May 3, 1919.

Record:

Training camp, May 14-July 29, 1917.

Sailed for France, August 14, 1917.

Reported to Chief Engineer A. E. F., September 2, 1917.

Investigation of military mining and relation of geology to field works in Arras-Vimy-Bethune sector, First British Army, October, 1917.

Investigation of geology, water resources, and field works on French front from Swiss border to Meuse River. About two months spent in field work on front, December, 1917-April, 1918.

Preparation of military geologic maps, water supply, and road metal reports and reports on physical character of terrain in Vosges Mts., Verdun sector. Some short field trips, but mostly office work. This included description of area within enemy's lines, May, 1918-November, 1918.

Preparation of summary reports on work of Geologic Section A. E. F. Application of geology to military problems, including work of German military geologists. Some field work was done, including trip down the Rhine, examination of the old front in France and Belgium, and a trip to Brussels to secure data on geologic work of the enemy, November 11, 1918-February, 1919.

Investigation of the iron and steel industry of northern France, Luxemburg, Belgium, and western Germany for Commission to Negotiate Peace. The special purpose of this investigation was to determine the use of the Lorraine iron ore. It comprised a statistical, economic, and geographic study of the data. Attached to Peace Commission doing above work at Paris, February 10, 1919-April 13, 1919.

At sea, Brest to New York, April 19-28, 1919.

Discharged from Army, May 3, 1919.

Charles F. Brooks.

Investigated for Chief of Weather Bureau the relation of ocean temperatures to long range forecasting with particular reference to the Western Battle Front in Europe.

Assisted in the preparation of maps in the Office of Farm Management, showing county distribution of crops requiring special labor requirements at certain seasons, the advance of the spring wheat, winter wheat and oats harvest, and the dates for seeding wheat to avoid injury by Hessian fly. These were published for general use and for use of the United States Employment Service.

From May to November, 1918, taught meteorology and weather

forecasting to the Signal Corps School of Meteorology at College Station, Texas; also taught meteorology and military road mapping in the Yale R. O. T. C.

Robert M. Brown.

Investigations in 1918 of the supply and depletion of oil and gas in Pennsylvania, Ohio and West Virginia.

James F. Chamberlain.

Taught course in Topography and the War to local S. A. T. C. unit.

William Churchill.

Committee on Public Information.

a. News censorship and control 1917-1918.

b. Temporarily *ad hoc* recalled to diplomatic duty by direction of the Secretary of State to prepare the American case on the disposition of the German Colonies in the Pacific.

G. E. Condra.

Organized and conducted State Congress on Conservation of Foods.

Director of Nebraska Conservation and Welfare Work.

Director of Military Survey of Nebraska, Chairman of sub-committees of State Council of Defense.

Gave course on Military Geography at the University of Nebraska.

Made special study of Potash Industry for Council of Defense.

Sumner W. Cushing.

As Captain in the Military Intelligence Division of the General Staff from July 29, 1918 to July 16, 1919, prepared and edited military handbooks and monographs and represented the War Department on various government committees, such as the Committee for the Selection of Maps to be used in the S. A. T. C. and the Committee on Economic Policy. The content of the military handbooks and monographs is largely geographical and is designed to give to a commanding officer all available data concerning his field of operations, so that he can lay sound strategical plans and order successful tactical movements. The monograph is also designed to assist officers in the administration of occupied territory.

N. H. Darton.

Chiefly concerned with a search for potash in the Redbeds of New Mexico and adjoining states.

As a member of a subcommittee of the National Research Council, gave considerable information regarding water supplies, etc., for camp

sites at several cantonments. As member of the U. S. Geological Survey, supplied data to the Army, mainly regarding camp sites near Washington.

Suggestion accepted that Fort Wingate, N. M., be selected for storage of part of great stock of TNT.

W. M. Davis.

In 1918 published "A Handbook of Northern France" of which nearly 4,000 copies were given to officers in various cantonments before they sailed for France, 5,000 were bought by the Y. M. C. A. for their hut libraries in France, and the balance were sold to the public.

Also, with aid of the Appalachian Mountain Club of Boston, prepared a guide book for "Excursions around Aix-les-Bains" our rest camp in the French Alps. 2,000 copies were sent to the Y. M. C. A. Secretary at Aix for free distribution.

Nevin M. Fenneman.

Division chief in charge of all scientific work in Africa, for Inquiry at American Geographical Society.

Chairman Research Committee, University of Cincinnati and arranged use of equipment for war purposes.

E. E. Free.

August 1917, entered army as Captain of the Ordnance Reserve Corps attached to the office of Chief Inspector of Small Arms Ammunition.

March 1918, assigned to Edgewood Arsenal, then a part of the Ordnance Department but later transferred to the Chemical Warfare Service. May, 1918, went to France on special duty in connection with the manufacture of war gases. On return in August, 1918, was attached to Edgewood Arsenal, still being used in connection with the manufacture of gases.

Discharged from the service June, 1919, with rank of Major, Chemical Welfare Service, United States Army.

H. A. Gleason.

Teacher in University of Michigan, conducting classes for the Student Army Training Corps.

James Walter Goldthwait.

Commissioned Captain, Military Intelligence Division, General Staff, April 8, 1918. Served until honorably discharged, Dec. 31, 1918, at Washington, D. C., first in charge of the map room of the Combat

Section, Military Intelligence Department, and later—from July 15th until December 31st, in charge of the Map Room of the Chief of Staff.

Work consisted principally in plotting promptly and accurately, in detail, news received by cable from all fronts, both as to changes in battle line and changes in disposition of troops, etc. Object of the work primarily to inform the Chief of Staff, Secretary of War and General Staff of the latest developments on all fronts, by graphic representation of news gathered from all official military and diplomatic sources abroad. Short oral reviews of the week's news were given, in the War Council Room to four groups,—Chiefs of Bureaus of the Army, Tonnage Conference group, House Military Committee, and Senate Military Committee.

Work developed under direction of Major Lawrence Martin, and was continued during his absence in Europe.

Herbert E. Gregory.

May 1, 1917, to September 1, 1917. In charge of the preparation of a special map of the Connecticut coast for Army and Navy purposes.

November 1, 1917, to May 1, 1918. Instructor in Reserve Officers' Training Corps, Artillery Unit, Yale University.

May 1, 1918, to July 1, 1918. Field investigations for the U. S. Geological Survey.

July 1, 1918, to October 1, 1918. With National Research Council, Division of Geology and Geography and Division of Educational Relations (part of the time as chairman of these divisions), engaged in selection of men for overseas duty, formulation of program of studies and preparing texts for the proposed Students' Army Training Corps.

October 1, 1918, to December 1, 1918. Educational director for the War Department for scientific subjects for the New England district, Students Army Training Corps.

A. J. Henry.

Replaced in the Washington Office of the Weather Bureau, another forecaster who was selected for duty in France.

Contributed to the preparation of Introductory Meteorology, issued by the National Research Council.

Ellsworth Huntington.

Enlisted in the Army June 6, 1918, with the rank of Captain. Served till July 18, 1919. Now Major in the United States Reserve Corps. Time spent entirely in Washington, first in the Military Monograph Sub-section; later made chief of separate section.

The work was the supervision of the preparation of geographic monographs and handbooks, giving every conceivable kind of informa-

tion in regard to countries where United States troops were operating or might be called upon to operate. A system was established which has been incorporated as a permanent part of the Army's plans for procuring the information which is inevitably needed in case of military operations in any part of the world. One of the largest pieces of work was the preparation of about sixteen little books on Russia and Siberia.

Mark Jefferson.

In charge of the map program of the "Inquiry" in New York from September 1 to December 2, 1918.

Sailed for Paris with the "Inquiry" on the George Washington.

Chief of the division of Cartography of the American Peace Commission in Paris till the end of May, 1919, and representative of the United States on the commission of expert geographers, representing the Great Powers, which exercised the final revision of all the lines and descriptions of boundary lines in the Treaties with Germany and Austria.

Worked for the Peace Commission in designing maps, mainly for the territorial experts and supervising their execution.

W. L. G. Joerg.

Indirect assistance in the preliminary work at the American Geographical Society of the American Commission to Negotiate Peace, known as the "Inquiry;" through the editing of articles and maps dealing with the geographical problems of the war for the Geographical Review; preparation of a series of pamphlets dealing with ethnographic and other topics to accompany a series of base maps prepared for the Inquiry; preparation for the Committee on Public Information of the official map of the new boundaries of Germany released to the press by that organization on May 7, 1919, with the summary of the peace treaty draft.

Douglas Wilson Johnson.

Chairman of the Executive Committee and one of the organizers of the American Rights League, a national organization active in mobilizing American public opinion in favor of entering the war against the Central Powers.

Author of the "Peril of Prussianism" a small book much used in pro-Ally propaganda in America, and reproduced in moving picture film propaganda in support of the war; also of "My German Correspondence" a letter to a German professor which went through large editions in French, Swedish, Portugese, and other foreign languages, and which was used by the British Ministry of Information in a

world-wide propaganda in support of the Allied cause; also of "Topography and Strategy in the War," a book much used by officers and men in the American Army, a special edition for the western front being issued by the National Research Council for distribution to army officers.

Member of New York Exemption Board No. 136, to select district quota for first draft army.

Member of Division of Geology and Geography, National Research Council, and as its foreign representative supplied the Council detailed reports on the use of geology and geography in the allied and enemy armies in Europe.

Member of staff of Experts assembled by order of the President at American Geographical Society to prepare data for the Peace Conference.

Commissioned Major in the Military Intelligence Division of the American Army, in January, 1918.

Detailed by the Secretary of War on a confidential mission to the European war fronts to study the relation of topography to strategy under modern conditions of fighting in Belgium, France, Italy, and the Balkans, March-October, 1918.

Appointed to study preparations being made in European capitals anticipating the peace conference.

Appointed by the Secretary of State as specialist in boundary geography with the American Commission to Negotiate Peace, December, 1918. Served as Chief of the Division of Boundary Geography, American Peace Commission, and as advisor to the President and Commissioners on various territorial problems, Paris, January-September, 1919.

Appointed by the Secretary of State to represent the American Government on the Roumanian, Jugoslav, and Central Territorial Commissions at the Peace Conference.

Technical advisor to the Department of State on European territorial questions, October, 1919.

William Libbey.

Entered service as Major, Ordnance Reserve Corp, February 1918.

Inspector of Rifle Demonstrators, visiting camps from Massachusetts to Alabama until May 1918.

Assistant Chief Instructor, Small Arms Firing School, Camp Perry, Ohio.

Promoted to Lieutenant Colonel, Infantry, September 1918.

Ordered to Washington as Chief Rifle Demonstrator October 1918. In charge of Demonstrators at the mobilization camps until November

1918. In charge of the work of examining, caring for, and preparing rifles for storage, as they were turned in by returning troops.

Honorably discharged, March 1919.

Alexander McAdie.

Enrolled as Lt. Commander in the U. S. Naval Reserve Force and served at home and overseas as Senior Aerographic Officer in the Navy.

There were trained at Blue Hill Observatory 58 graduates of 28 American Universities, of which 52 received commissions. 30 of these saw service in Ireland, France and Belgium.

G. R. Mansfield.

From July to September 1917, investigated the reported occurrence of coal in eastern Idaho, with a view to securing data that would help relieve the coal shortage that had been acute in that section the preceding season.

From December 1917 to April 1918, engaged with others in a detailed and quantitative study of the nitrate deposits of the Amargosa Valley in southeastern California to see if these deposits could be utilized and thus relieve tonnage in the Chilean nitrate trade.

In August 1918, collaborated with others in the preparation of the course in the geography of Europe for the S. A. T. C. of the War Department.

In October 1918, sent to New Jersey to study the glauconite deposits as a possible source of potash and to obtain quantitative data which could be useful in exploitation of the deposits.

C. F. Marbut.

The Bureau of Soils arranged its work the winter of 1918-19 in accordance with a request of the War Department so as to cover those areas in Georgia, South Carolina and some of the other states where the original map data desired by the War Department to make the Progressive Military Map of the United States was most deficient. In addition to doing this field work, the Bureau supplied the War Department with advance sheets of original maps of many counties which had previously been surveyed; also furnished certain data on the nature of the soil and sub-soil in places that were under consideration as posible sites for encampments of various kinds.

Prepared, at the request of the American Geographical Society, a map of the soils of Africa, based on the existing literature for the use of the Peace Commission.

Lawrence Martin.

Major, General Staff, U. S. Army

April to May, 1917, instructing students of University of Wisconsin in making maps as part of intensive course in military training.

May to July, 1917, civilian instructor in Topography in First Training Camp for Officers, Ft. Sheridan, Ill., after discharge from candidacy for commission because of defective eyesight.

August to December, 1917, 1st Lieut., N. A., Instructor in Topography, and Assistant to the Senior Instructor, Second Training Camp for Officers, Ft. Sheridan, Ill.

January to March, 1918, map officer of Military Intelligence, Army War College, Washington, D. C., also in charge of maps for the War Council.

March to July, 1918, Captain, N. A. ,in charge of Secret Map Room for Secretary of War and Chief of Staff, also giving weekly summaries of combat to Senate Military Committee, House Military Committee, general officers in charge of War Department bureaus, and chiefs of War Trade, War Industries, Shipping, and other boards, and assisting General March at conferences with newspaper correspondents; member of Division of Geography and Geology, National Research Council.

August to November, 1918, Major, General Staff, attached to G-2 (Military Intelligence), G. H. Q., A. E. F.; Military Observer with British corps on the Somme during advance from Albert to Hindenburg Line; with General Dickman's corps during St. Mihiel offensive; with one of General Bundy's divisions in the Vosges; attached to General Treat's Mission in Padua, and with various Italian and British units on the Italian Front, and with 332nd American Infantry in final offensive to and east of the Tagliamento.

November, 1918, to December, 1919, attached to American Commission to Negotiate Peace as Chief, Geographical Section, Military Intelligence, U. S. Army: (a) In Paris the first 6 weeks; (b) in Vienna and travelling throughout Austria-Hungary, Ukraine, and Roumania, January to June, 1919, engaged in getting maps for the Peace Conference and in geographical field work on territorial questions, including the Klagenfurt Basin problem of Carinthia, the Ruthenian problem of northeastern Hungary, the Vorarlberg-Liechtenstein problem of western Austria, the East Galician-Bukovina problem of Poland-Ukraine-Roumania, and the problem of the Germans of West Hungary (finally drawing the whole eastern boundary of Austria); (c) in Paris June to August, 1919, as geographical expert and member of various international subcommittees on boundaries, working on the modification of the Czechoslovak, Hungarian, and Austrian frontiers in the light of the notes from the Austrian Delegation, and on phases of boundary determination in Orava and Teschen between the Poles and Czechoslovaks, along the northern frontier of Jugoslavia, on the east coast of the Adriatic, in Thrace, in Bukovina, etc.; (d) August

24 to October 24, 1919, geographer to the Harbord Mission to Armenia, travelling by rail from Constantinople to the end of the Bagdad Railway in Mesopotamia, by automobile from Mardin to Diarbekr, Kharput, Malatia, Sivas, Amasia, Samsoun, Trebizond, Baiburt, Erzerum, and the old Russian frontier, then by rail to Kars, Erivan, Tiflis, and Batum; (e) November-December, 1919, in Berlin, Leipzig, Frankfurt-am-Main, and Coblenz; returned to United States, December 21, 1919.

Since January, 1920, on duty in Washington in Military Intelligence Division, General Staff, and working on certain phases of the Hungarian and Turkish treaties, for the State Department.

François E. Matthes.

1. Made special geographic and geologic examinations of the regions about Camp McClellan, Ala., and Camp Gordon, Ga., and prepared geographic descriptions of these areas for the use of the army. These descriptions were published by the U. S. Geological Survey on the backs of the topographic maps of Anniston, Ala., and Camp Gordon and Vicinity, Ga.

2. Made a special report on the geology of the Anniston region (with special reference to materials available for building, road construction, etc., and to water supply from wells, springs, etc.), at the request of the Quartermaster at Camp McClellan.

3. Assisted in translating from the French the *Manual for Artillery Orientation Officers,* the instructions contained therein being of particular value to the topographic engineers of the U. S. Geological Survey who were detailed to serve with the army in France in the capacity of Orientation Officers for the Heavy Artillery. The Manual was issued first by the U. S. Geological Survey, but a large edition with additional appendices has also been published by the Army War College.

It may be said in explanation that an Orientation Officer is essentially an expert in modern topographic methods who determines on the map the positions of batteries and targets and thus furnishes the battery officers with accurate data for long-range firing. The effectiveness of long range barrages and shelling generally in the late war depended largely upon the accuracy of the Orientation work.

Oscar Edward Meinzer.

On October 23, 1918, was commissioned Captain of Engineers and ordered to proceed to France for duty as a geologist, and as a ground water specialist.

Discharged from the Army December 14, 1918.

George J. Miller.

Application for Y. M. C. A. work still pending when war ended.

George E. Nichols.

Acted as Botanical Advisor on Sphagnum for American Red Cross: (Sphagnum moss was extensively used as a substitute for cotton in absorbent surgical dressing). My work here consisted in (a) exploration for sources of supply and directing similar investigations by other workers in various parts of the East; (b) passing judgment on material submitted for examination; (c) propaganda, both by letter and published articles.

Taught Military Mapping in Yale S. A. T. C.

Contributed to Gregory's textbook on "Military Geology and Topography."

A. E. Parkins.

During the fall of 1918, had charge of the S. A. T. C. work and taught geography, meteorology and map making and drawing courses at George Peabody College for Teachers.

Harry Fielding Reid.

Was a member of the Foreign Service Committee of the National Research Council which was sent to Europe in the spring of 1917 to report on the application of science to the conduct of the war.

G. B. Roorbach.

In May, 1918, was appointed Special Expert in the Division of Planning and Statistics of the United States Shipping Board and served in that capacity until September first, 1919.

During the period following the armistice, was appointed chairman of the Inter-departmental Committee for the Revision of Trade Statistics by Secretary of Commerce.

R. D. Salisbury.

Prepared a bulletin on the Geology and Geography of the Camp Grant region for use at the cantonment there.

C. S. Scofield.

With E. C. Chilcott, T. H. Kearney, made an expedition to Algeria, from August to November, 1918, at the request of the French Government, having in view the stimulation of wheat production in Algeria. Time in Algeria was about seven weeks, spent studying agricultural conditions and advising as to methods and machinery for increasing grain production, particularly under the semi-arid conditions of the high plateau of Algeria.

Ellen Churchill Semple.

Lectured before classes of officers, at Camp Zachary Taylor, on the military geography of the Italian front, during the autumn of 1917.

Worked for the " Inquiry " in New York City from December 1917 to December 1918.

Homer LeRoy Shantz.

Part of 1918 with " Inquiry " to determine natural plant resources and crop producing possibilities of large portions of Africa for the use of the Allied Peace Commission.

Representative of the Department of Agriculture as Agricultural Explorer, accompanying the Smithsonian African Expedition in South Africa, 1919.

J. Russell Smith.

April, 1917. Served as chairman of committee on agricultural service, University of Pennsylvania and within three weeks sent some three hundred boys to the farms in many states.

May and June, 1917. Wrote three articles, by special request, for the Country Gentleman, urging national food campaign.

April, 1917, to November, 1917. Served as chairman Food Commission, Philadelphia School Mobilization Committee, and chairman Food Section, Mayor's Home Defense Committee.

July and October, 1917. Articles in Review of Reviews urging League of Nations and ship-building campaign.

November, 1917, to June, 1918. Prepared 347-page report for Carnegie Endowment for International Peace, " Influence of Great War on Shipping."

July, 1918, to January, 1919. Special Trade Expert, Bureau of Research, War Trade Board, Washington, D. C., in charge of preparation of miscellaneous reports.

J. Warren Smith.

Service rendered in the preparation of climatological data of foreign countries to be used in the consideration of a peace program and conditions. In connection therewith, the division of Agricultural meteorology was given the general charge of compiling all climatological, agricultural and meteorological data concerning foreign countries for use by other branches of the Government.

The most important work done by the division was the preparation of very complete climatological maps of Africa.

Philip S. Smith.

Throughout the war, the main service rendered was as Administra-

tive Geologist and Acting Director of the Geological Survey. Article on the United States Geological Survey war work printed in Economic Geology, Volume 13, July 1918, pages 292-339, indicates the scope of the work of the administration of the Survey.

Served as geologist in charge of the sulphur and pyrites investigations, which furnished basal information regarding the production and status of these industries so important for the manufacture of acids needed in munitions work.

Member of the Division of Geology and Geography of the National Research Council, an associate member of the District of Columbia Legal Advisory Board for Draft Registrants, and a member of several committees investigating special problems, such as the Committee for the Selection of Maps for the Committee on Education and Special Training for the War Department, both for the Students' Army Training Corps and for "War Issues."

Walter S. Tower.

Service confined to work with the Division of Planning and Statistics of the United States Shipping Board.

Work consisted principally in general managerial duties of running the Division, which totaled about 325 people at the time the Armistice was signed, and in personal direction of the work on Import Program, by which efforts were being made to minimize the use of shipping for commercial purposes in order to realize for military needs the maximum tonnage possible.

Sent for a brief time in October 1918 to work with the American Section of the Allied Maritime Transport Council in London. Sent on return as one of the Shipping Board staff to Paris, to work in connection with the Commission to Negotiate Peace, and for something over two months remained there, both with the Paris office of the Shipping Board and with the American Section of Economics and Statistics of the Peace Commission.

T. Wayland Vaughan.

Requested, shortly before the United States entered the war, by the Director of the United States Geological Survey, to take charge of a compilation and digest of information on the water resources, particularly for military purposes, of the entire border part of the United States except the Canadian border, and the work was done in collaboration with a number of geologists and some engineers.

After the United States entered the war, time spent in supplying information to army and navy officials in compliance with requests received by the United States Geological Survey. The subjects included:

a) Information on water supplies for cantonments and other kinds of military and naval establishments.

b) Data on road building material and material for other structural purposes.

c) Studies of the nature of foundations of different kinds of structures.

d) Assistance in the selection of sites for several different kinds of military and naval establishments.

e) Data for use in compiling the progressive military map of the United States.

Robert DeC. Ward.

Gave instruction in Meteorology at the U. S. Army School of Military Aeronautics at the Mass. Institute of Technology, and, at the request of the Chief Signal Officer, prepared a manuscript on Meteorology in Relation to Military Aeronautics adapted for use at all the Army Schools.

At Harvard, gave regular courses in Meteorology, attended by members of the R. O. T. C. and of the S. A. T. C. Also, gave a special course in Marine Meteorology for members of the Naval Reserve, and special lectures to men enrolled in the Air Service program.

Published a series of a dozen articles on weather controls over military and naval operations during the war.

R. H. Whitbeck.

Volunteer instructor at the University of Wisconsin in the first Reserve Officers' Training Corps; also an instructor in the Student Army Training Corps.

Spent the summer of 1918 in Washington acting as Assistant Director of the Bureau of Research of the War Trade Board.

Bailey Willis.

In May, 1918 was appointed Chief of the Latin American Division of the "Inquiry." The work was carried on to March 1919, with a force which varied from three to twenty persons.

The investigation was of peculiar geographical interest. Thus the review of twenty odd boundary disputes involved geographical-historical research covering all of South America. A particular dispute between Uruguay and Argentina regarding jurisdiction over the waters of the La Plata, brought out the significant bearing of geographical facts on the legal questions involved in territorial waters as contrasted with high seas. The Tacna-Arica dispute between Chile and Peru led into a geographical study that went back to the days of Pizarro.

Another group of questions had to do with the resources of geo-

graphical districts and was based on topographical, meteorological, and botanical studies.

Ethnic research was required in the preparation of data on population, stage of culture, and capacity for self government. Engineering investigations were directed to the assembling of information as to trade routes, railway systems, built or strategically necessary waterpowers, harbors, etc. Commercial relation formed another group, based also on geography.

Available maps having been found inadequate, a base map of all Latin America was prepared from original sources. It is on a scale of 1:2,000,000, or 32 miles to an inch and covers 29 sheets. It includes Mexico, Central America, the West Indies, and South America, from the Rio Grande to Cape Horn. The compiled data comprise drainage, political boundaries, railroads and roads, and places. The original draft of this map was sent to Paris, and an edition of 300 copies was printed for official use.

A draft of this map, reduced to 1:5,000,000 was also prepared.

TITLES AND ABSTRACTS OF PAPERS

BALTIMORE, 1918

Nevin M. Fenneman.

Presidential Address:—The Circumference of Geography. (Printed in full herewith.)

Wallace W. Atwood.

The Call for Geographers.

The war has emphasized the need of more trained geographers in America. The Army has called many into service, the Shipping Board has taken others. Some have been sent to France to act as experts; others have served in this country, either in the training of officers or in the organization of geographical data of special significance to the Army, the Navy, and the Department of State. The French and British nations have made similar demands upon their trained geographers. Some of the American colleges and universities have recently put in requests for trained geographers. There appears to be a great awakening in this country to an appreciation of the value of advanced studies in geography.

We are entering a period of maritime expansion. More men will be needed to go as representatives of great commercial houses in different parts of the world. Our Diplomatic Service will undoubtedly be increased. Those who attempt to represent us abroad should know the geography of this country, and should understand the influence of geographic conditions upon the peoples with whom they must deal. We must know better the peoples of the world, and to accomplish that we must know better the geography of the world. To improve the teaching of geography in this country opportunity must be given to those who teach the subject to know more than they are required to teach. Every college and every university in this land should open departments of geography or expand their present offerings in the science.

See, Geographical Review for January, 1919, pages 36-43.

O. E. Baker and H. M. Strong.

Arable Land in the United States.

The purpose of this paper is to describe the location and extent of present arable, non-arable and potentially arable land in the United States, with a view to providing those interested in land utilization with a broad, generalized conception of the subject.

"According to the best information, we have in all about 850,000,000 acres of land at present in crops and potentially available for the pro-

duction of crops. This is 45 per cent of the total land area of the United States, or about the same proportion the arable land of France is of the total area."

"Of these 850,000,000 acres nearly 480,000,000 acres were 'improved' in 1910. The remainder consists of about 200,000,000 acres of potentially arable forest and cutover land, of which probably more than one-half is at present included in the 190,000,000 acres of woodland in farms; 60,000,000 acres of swamps and other wet lands awaiting reclamation by drainage; 30,000,000 of potentially irrigable land; and about 80,000,000 acres of other lands, mostly 'unimproved land other than woodland' in eastern farms and dry-farming land in the west."

"These undeveloped lands may provide eventually about 3,000,000 farms, an increase of somewhat less than 50 per cent over the number of farms in the United States to-day. But unquestionably the better and the best land which it has been possible to develop by individual effort is now 'improved' land in farms, and much of that which remains undeveloped must await the gradual application of large amounts of capital to its development."

"The 1,000,000,000 acres of more or less non-arable land consists of about 360,000,000 acres of absolute forest land; that is land not adapted to crops but where climatic conditions permit the growth of forests; 615,000,000 acres of grazing land, practically all in the western States; and 40,000,000 acres of absolute desert land. In addition there are about 40,000,000 acres of land at present in cities, rural highways and railroad rights of way, an amount which will gradually be added to with increasing population. (See, Yearbook of the Department of Agriculture, 1918, pages 433-441, 10 plates.)"

Chas. F. Brooks.

Ocean Temperatures in Long-range Forecasting.

The slow, and more or less persistent changes in the temperature of the ocean waters over extensive areas, or in ocean currents, suggests the desirability of making a systematic study of temperature variations in connection with subsequent changes over adjacent land areas.

If it is possible (1) to forecast the distribution of surface water temperature a few weeks in advance, it may prove possible (2) to forecast the general paths which will be followed by cyclones and anticyclones, and then (3) from the winds which will result, to make long-range forecasts of the general weather to be expected in any period. (See, Monthly Weather Review for November, 1918, pages 510-512.)

William Churchill.

The Colonies, late German, in the Pacific.

G. E. Condra.

Potash a Factor in Winning the War.

(See: Final Report of the Nebraska Conservation and Soil Survey, 1919, on "Potash in Nebraska.")

Henry C. Cowles.

The Present and Past Climates of our Leading Crop Plants.

There are three great centers of origin of the major crop plants: Indo-Malaysia, Tropical America, and the Levant. Indo-Malaysia and Tropical America have given rise to most of the tropical crop plants; most of these derivatives have their major cultivation in the Tropics, though maize is a conspicuous exception to this. The plants derived from the warm temperate Levant, however, are the great crop plants of the cold temperate zones, and their present Levantine cultivation is decidedly of minor importance. The great staple crops of northern Eurasia, the United States, Argentina, South Africa, and Australia are not of native, but of Levantine origin. For this strange situation at least five theoretically possible reasons may be cited: (1) Gradual century-long acclimatization. (2) the origin, by mutation, of cold temperate races. (3) Climatic changes during the period of human culture. (4) The fact that species are not necessarily best suited to their place of origin. (5) Agricultural extension is possible without acclimatization.

William Morris Davis.

Work of the Geography Committee of the National Research Council.

Physiographic Evidence for Subsidence of Reef-encircled Islands.

Richard E. Dodge.

Some Aspects of the Food Problem—Read by Title.

The food needs of our Allies and of the increased populations in war industry centers, made necessary sudden, and in some cases revolutionary and confusing, changes in the food production program in our eastern states. Sections previously interdependent for necessary food products and farm supplies were suddenly thrown largely on their own resources and were obliged to alter their agricultual practices accordingly.

The farmer today must face increased costs of all essentials, new market needs and demands, a decreased supply of available labor, and the necessity of using new types of labor. Every condition affecting his work has changed.

Chas. R. Dryer.

The Maumee-Wabash Waterway (Printed in full herewith).

F. V. Emerson.

The Southern Longleaf Pine Belt.

"The Southern Longleaf Pine Belt is one of the most available regions for development in farms for returning soldiers. It includes an area nearly four times that of New York. Probably a third of the region has now been cut over and an area nearly equal to that of Massachusetts is being cut over each year. These lands have the advantage of present availability in a short time and without great expense; they are fairly near to markets and the climate is favorable. However they must usually be cleared of stumps, brush and undergrowth and the soils have relatively low fertility. These lands are readily adapted to grazing, less easily to truck and crops. A portion should be reforested."

(See, Geographical Review for February, 1919, pages 81-90, illustr.)

Herbert E. Gregory.

Geography in the Work of the Students Army Training Corps.

Organization of Geographic Instruction in the Universities.

Roland M. Harper.

A Statistical Study of New England Geography.

Alfred J. Henry.

Increase of Precipitation with Altitude.

Summary:—The main features of the precipitation-altitude relation are essentially as follows:

1. The trend of the mountains must be in such a direction as to cause an ascent of the air masses which encounter them. Mountain systems whose axes are parallel, or nearly so, with the direction of the rain winds cause little or no increase in precipitation.

2. The inclination of the slope of the mountain is of great importance; the steeper the slope, other things being equal, the greater the precipitation. The quantity of rain or snow which falls anywhere is also conditioned upon the initial temperature and relative humidity of the air at the beginning of the ascent. Obviously it also depends in no small degree upon the duration of the winds from the rain quarter, or upon the rate of movement of the atmospheric disturbance with which the rain winds are associated.

3. The altitude of the zone of maximum precipitation appears to vary slightly with latitude, being lowest in the tropics—a little less than 1000 meters—and highest in the temperate latitudes between

1400 m. and 1500 m. elevation. It has also a seasonal variation, being highest in summer and lowest in winter. (See, Monthly Weather Review for January, 1919, pages 33-41.)

Edmund Otis Hovey.

Geographical Notes on the Greenland Coast from Melville Bay to Etah.

Melville Bay presents an almost continuous ice front formed by glaciers and tongues coming down to sea level from the Inland Ice Cap. The principal breaks in this 300-mile wall of ice are Red Head, Cape Sedden, Cape Walker, Cape Murdock and Cape Melville. The islands paralleling the coast present no permanent ice cap. From Cape York northward the coast presents a fringe of bare land of varying width intersected by countless glaciers. These present all stages of development and are valuable for study.

Willis T. Lee (Introduced).

Notes on the Geography of the Rocky Mountain National Park, Colorado.

Douglas W. Johnson.

Geographical and Geological Work in the Allied and Enemy Armies.—Read by Title.

An account of the geographical and geological services rendered to the armies of our allies and to the German armies by experts in the two sciences.

C. F. Marbut.

Relation of Soil to Topography.

R. A. Millikan. (Introduced.)

Some Scientific Aspects of the Meteorological Work of the United States Army.

" There is no more interesting illustration of the application of new scientific methods to warfare than is furnished by the developments in meteorology during the Great War. Prior to 1914 a meteorological section was not considered a necessary part of the military service. No corrections had ever been made by the artillery of any army for any save surface winds. Firing by the map was almost unknown. No Sound-ranging Service, no Air Service, and no Anti-aircraft Artillery had ever existed to demand aerological data.

"At the time of the signing of the armistice on the western front the Air Service and all the artillery were being furnished every two hours with the temperature, air-density, wind speed and direction,

taken at the surface and at various altitudes from 100 to 500 meters apart, up to 5000 meters. Further, tables were prepared from which each battery could obtain the correction suited to its trajectory for the so-called ballistic wind. This is the average wind for the trajectory, weighted for the density of the air at the elevations traversed. Even machine guns when used for barrage work made use of these ballistic wind tables."

" In addition, daily forecasts were furnished to the armies in accordance with the following outline:

A. Character of weather for each arm of the surface.
B. Winds; At surface, at 2,000 meters elevation, at 5,000 meters.
C. Cloudiness, including fog and haze.
D. Height of clouds.
E. Visibility.
F. Rain and snow.
G. Temperature.
H. Warning of weather conditions favorable for use of gas by the enemy.
K. Probable accuracy, or odds in favor of the forecast."

" Most of the aerological data were obtained from theodolite observations on pilot balloons. The extent to which our knowledge of the upper air has been and is being extended by this pilot balloon work may be seen from the fact that before the war there existed but one station in the United States where pilot balloon observations were carried on regularly. Within a year of the inception of the meteorological service in the United States Army, 37 complete stations for the obtaining of both surface and upper-air data in aid of aviation and the artillery had been established in the United States and equipped with special aircraft theodolites and pilot balloons, neither of which had ever been produced before in this country. Further, 20 such stations had been established by our forces abroad. For the manning of this service, about 500 specially selected men had been trained in this country, and 314 of them sent abroad, while about 200 were held for work in the United States."

" The scientific interest in this service centers about four distinct problems:

1. The extension of our knowledge of the law of motion of pilot balloons.
2. The procurement of data and the development of methods for the preparation of artillery range tables.
3. The development of long-range propaganda balloons.

4. The charting of the upper-air in the United States and overseas in aid of aviation."

(See, Monthly Weather Review for April 1919, pages 210-215.)

Frederick Morris. (Introduced.)

The Terrain and the War in Italy.

A brief account of the Terrain in general introduces the subject. The Plain of Northeastern Italy presents two aspects, a Piedmont belt of confluent alluvial cones with braided rivers, and a lower more richly watered and more densely peopled shoreward region. Along the coast the swampy delta lands with their network of canals and canalized streams formed a third aspect presenting special military problems.

The mountains rise abruptly above the plain, and present in general a twofold aspect that has profoundly conditioned the military operations. Along the southern edge of the great upland is a fringe of unglaciated "plateaus," cut by youthful river canyons. Behind these lies a sea of alpine peaks and long chains of arêtes. Enormous glacial gorges cut through the glaciated and unglaciated regions, reaching to the plain in some cases, in others, as in the Isonzo below the Tolmino basin, changing to typical V-shaped youthful valleys. The broadly rounded unglaciated mountains, such as Asolone, Grappa, Tomba, Baldo, Valbella, admit of larger movements of troops and artillery than is possible on the Alpine peaks, so that the defence of this unglaciated fringe of hills has more nearly resembled that of the French at Verdun than has any other fighting on the Italian front.

The elevated, undulating uplands called plateaus in the news despatches, such as the Lavarone, Folgaria, Asiago, Carso, Bainsizza, had yet other problems for the armies engaged across them.

The events of the war were analyzed by the author in their relation to the topography and geology of the region.

Ellen C. Semple.

Geographic and Climatic Factors in the Ancient Mediterranean Lumber Trade. (Printed in full herewith.)

The Ancient Piedmont Route of Northern Mesopotamia.

Eugene Wesley Shaw.

The So-called Lakes of the New Madrid Earthquake Area.

It is generally supposed that numerous rather extensive tracts in southeastern Missouri and northeast Arkansas subsided at the time of the New Madrid earthquake of 1811-12, and all maps of these states show many lakes and swamps. The tracts are widely known as "sunk lands."

As a matter of fact, however, there are few lakes, and even swampy conditions do not seem much more characteristic of the "sunk lands" than of intervening territory. This general fact has become more or less well known to the people living in the region and to others who have had occasion to travel through this heavily forested portion of the Mississippi bottom lands; but maps published in atlases and elsewhere have not yet been corrected.

Title to the lands represented as lakes hangs on the correctness of the original Government land survey made seventy or eighty years ago. If this survey was correct and the lakes have become filled or drained, their fertile beds must now be parceled out among those owning bordering lands—the riparian claimants. If however the old surveys were erroneous the lands are now, it is claimed, the property of the nation and open to homestead. H. C. Cowles, as ecologist, and the writer as a student of sediments and surface features, have been called upon at various times to testify as to whether certain "lakes" or groups of "lakes" have been lakes within the period involved. Notwithstanding the fact that the lands are all subject to overflow it has been possible to gather convincing evidence that the old land surveys were erroneous so far as the lakes are concerned.

Thomas Wayland Vaughan.

Some Features of the Virgin Islands of the United States.

The name Virgin Islands seems not to apply to a natural group, for it is applied, first, to the islands that lie between the east end of Porto Rico and Anegada Passage and rise above the shallow Virgin Bank, which is really only an eastward, slightly and recently submerged extension of Porto Rico and is bounded by deep water on its northern, eastern, and southern sides. If the Virgin Islands included only the protuberances above the surface of this bank, the name would seem logical enough, but when they include Saint Croix, which is separated on the south from the Virgin Bank by water 2,400 fathoms deep, there appears to be no geographic unity in the group. However, at a time geologically not long ago no oceanic abyss separated Saint Croix from Porto Rico and the Virgin Bank, and then they all formed a part of a natural group.

The relations of the Virgin Islands to the principal Caribbean ridges and deeps.

There are two roughly east and west main Caribbean ridges. The first is the Cuban ridge and the second is the Rosalind Bank—Jamaican ridge. The Cuban ridge, notwithstanding its interruption by the Windward Passage, is continued into northern Haiti; while the Rosalind

Bank—Jamaican ridge is prolonged into southern Haiti. These prominent tectonic features converge in Haiti. It would lead too far afield to attempt a more special account of these relations in this connection, but they are not so simple as might be inferred from the statement just made. Porto Rico is on a bank extending eastward from Haiti, from which it is separated by water having a maximum depth of 318 fathoms in Mona Passage. Virgin Bank, as has been stated, is only a slightly submerged part of Porto Rico.

The principal deeps of the Caribbean region are Bartlett and Brownson deeps, but there is relatively deep water on the two sides of the important ridges, and the water in both Windward and Angada passages is 1,000 fathoms in depth.

The other Caribbean ridges are the Barbadian Ridge, the Main Caribbean Arc, with the two prongs of its more northern part, and Aves Ridge. The Main Caribbean arc terminates at the north at Anegada Passage.

Saint Croix is connected by shallower water with the Saint Christopher Chain than any other islands and might on this ground be considered as naturally forming a part of the inner prong of the Caribbean Arc, but its geologic kinship is with Saint Thomas and Porto Rico.

Islands of the Virgin Bank.

There are about 100 of these islands, and needless to say no such number of islands can be described in this brief statement. They were discovered by Columbus during his second voyage in 1493, and had a more or less thrilling history during the buccaneer days prior to 1666, when Tortola, Virgin Gorda, and Anegada came into the possession of the British. The Danes colonized Saint Thomas and Saint John in 1672; and the Dutch settled in Saint Croix in 1643. The possession of the Virgin Islands is now divided between the United States and Great Britain. The United States has dominion over the islands between Porto Rico and the Virgin Passage and over Saint Thomas and Saint John; while the British islands, about 32 in number, include Virgin Gorda, Tortola, and Anegada.

Except Anegada, which is composed of limestone and rises only 30 feet above sea level, the islands on the Virgin Bank are high and rocky. The peaks on some of the different islands attain heights as follows: Saint Thomas, 1,500 to 1,550 feet; Saint John, 1,270; Jost Van Dyke, 1,070; Tortola, 1,780; Virgin Gorda, 1,370. The summits of the peaks therefore range from about 1,000 to about 1,800 feet in altitude. The material composing the islands is largely of basic igneous rocks (andesite and andesitic tuff and agglomerate) but there are some

sediments and Cleve collected Cretaceous fossils in these on Saint Thomas. They are not composed of coral rock. The land areas have been well dissected by erosion and they are bordered by typical shore lines of submergence. The sea bottom is terraced in a most interesting way, as the charts and profiles based upon the charts show. This is a famous coral-reef region, the growth of certain species of corals being the most luxuriant known. As I have discussed in several papers the conditions under which the reefs of the Virgin Bank formed, I need not say anything special on them in this place.

The harbors of Charlotte Amalia, St. Thomas, the Coral Bay, Saint John, are both good, but that of Charlotte Amalia is exposed on the south and may be raked by hurricanes, while Coral Bay is protected on all sides.

Saint John, an irregularly shaped, narrow island, 8 miles long, is forested, and bay leaves, used in the manufacture of bay rum, are gathered there. Its soil is said to be fertile, and in the days gone-by coffee, sugar, and tobacco were produced, but at present cattle raising is the principal industry. In both Saint John and Saint Thomas there has been lack of labor to cultivate the small areas of arable land on them. Saint Thomas, which is 12 miles long and 3 miles wide, has lost the importance it once enjoyed as a port of call for vessels, because of a combination of circumstances, one of which was the laying of submarine cables. However, it is still an important coaling station, and the floating docks are used for repairing disabled ships. It appears to me probable that sea-island cotton, which is profitably cultivated on many of the islands farther south, might be grown on some tracts of land. The population is almost entirely black or colored—there were in 1917 about 960 inhabitants on Saint John and about 10,190 on Saint Thomas. The white houses with red-tiled roofs, arranged on the sloping sides of the hills that rise above Charlotte Amalia Harbor, are very attractive, and I wish that I might dwell on their charm.

Saint Croix.

Saint Croix, which was at first named Santa Cruz, was another of the islands discovered by Columbus on his second voyage in 1493. It is about 40 sea miles nearly due south of Saint Thomas on the other side of one of the most remarkable abysses in the world. According to the hydrographic chart the ascent from the sea floor north of Saint Croix in places is at an angle of as much as 70 degrees. There is an ascent of 13,656 feet within a horizontal distance of 25,800 feet. As the west end of the island is approached from Saint Thomas, the steep

north coast is most impressive—it is one of the finest known examples of a fault shore line—the faulting having taken place so short a time ago that the sea has barely cut a niche into the fault plane. In fact, the rather frequent violent earthquakes in this locality show that fault movement is still taking place.

There are two dominant geologic formations in Saint Croix, namely: One of older, tightly folded rocks, composed partly of Cretaceous sediments and partly of igneous rocks, which occur in the northern part of the western half, constitute most of the eastern half of the island. The higher hills are composed of these rocks. The other rocks are gently tilted limestones, that form a plain sloping southward from the well-dissected northern hills of the western half of the island and at a place a little west of Christiansted extend through a gap in the hills and reach the north shore. This limestone is not coral work, for corals are a very minor constituent of it. The hills represent a stage of mature dissection and range in altitude from about 800 to 1,164 feet, the latter figure being the height of Mount Eagle, the highest summit on the island. The shore line is indented by arms of the sea and is a good example of a shore line of submergence. Barrier coral reefs are well developed at several places off the shore, but it is interesting to note that there is no barrier reef where the shore follows the line of a steep fault plane.

I have indicated in preceding remarks that there is similarity in the older geologic formations (the Cretaceous) of Saint Croix and Saint Thomas, and that the abyss separating Saint Thomas and Saint Croix is the result of faulting of a geologically late date. The abyss just mentioned is prolonged into Anegada Passage. A continually increasing volume of biogeographic data seems to demand land connection from Porto Rico to Anguilla and to Saint Croix during either Miocene or Pliocene time, and that Saint Croix and the islands of the Virgin Bank then formed part of one land area, which has been broken into separate masses by block faulting. Although now dissevered, there was a time when Saint Croix was not isolated from its kindred islands some 40 miles farther north.

Christiansted, the capital of the island, had in 1917 a population of 4,574, while the population of Frederiksted was at that time 3,144. The total population of St. Croix is about 14,900, mostly negroes or colored people. A large proportion of the land on the island is arable and fertile. The principal industry is raising sugar cane, from which sugar and rum are made, but some attention is now paid to sea-island cotton.

I wish that I might say more about these islands, for they possess

many interesting and delightful features. Under ordinary conditions, they are all easily accessible from New York, and I am confident that those who may visit them will find pleasure and scientific profit in the excursion.

Bibliography.

The following are some of the more important references to literature on the geography of the Virgin Islands:

British Admiralty, West India Pilot, vol. 2, 6th ed., pp. 298-355, London, 1909.

Cleve, P. T., On the Geology of the Northeastern West India Islands: Kongl. Svensk. Vetensk. Akad. Handl., vol. 9, No. 12, pp. 48, 2 maps, 1871.

Hartley, Eugene F., Census of the Virgin Islands of the United States, Nov. 1, 1917: Bur. of the Census, Dept. of Commerce, pp. 174, 15 figs., 1918.

Hill, Robert T., Pelé and the Evolution of the Windward Archipelago: Geol. Soc. Amer. Bull., vol. 16, pp. 243-288, pls. 43-47, 1905.

Quin, John T., The Building of an Island, being a Sketch of the Geological Structure of the Danish West Indian Island of Santa Croix, or Santa Cruz, pp. 106, 1 Map, 32 text figs. Published by the author, Christiansted, Saint Croix, 1907, (This is a memoir of very great value.)

Taylor, Chas. Edwin, Leaflets from the Danish West Indies, pp. 228, illustrated by numerous unnumbered wood-cuts. Published by the author, at Saint Thomas, Danish West Indies, 1888.

Vaughan, T. W., Some Littoral and Sublittoral Physiographic Features of the Virgin and Northern Leeward Islands and their Bearing on the Coral Reef Problem. Washington Acad. Sci. Jour., vol. 6, pp. 53-66, 1916.

Vaughan, T. W., Fossil Corals from Central America, Cuba, and Porto Rico, with an Account of the American Tertiary, Pleistocene, and Recent Coral Reefs: U. S. Nat. Mus. Bull. 103, pp. 180-524, pls. 68-152, text figs. 4-25, 1919.

Vaughan, T. W., The Biologic Character and Geologic Correlation of the Sedimentary Formations of Panama in their Relation to the Geologic History of Central America and the West Indies: *Ibid.*, pp. 547-612, 1919.

Lists of the hydrographic charts for the Virgin Islands are contained in the catalogues issued by the United States Hydrographic Office and the British Admiralty. Prof. Oliver L. Fassig has in preparation a report on the climatology of the islands.

Robert DeC. Ward.

Rainy Days and Rain Probability in the United States.

The diagram of geographical distribution of rainy days shows over 100 rainy days per year east of the Mississippi River, with a maximum area of 170 days in the Lake region. West of the Mississippi the frequency varies from a minimum of 20 per cent in the arid southwest to over 80 in the Rocky Mountain District. In a narrow band along the extreme northwest coast the annual frequency attains an average value of from 120 to 180 rainy days. (See Geographical Review for January 1919, pages 44-48.)

ABSTRACTS OF PAPERS

Read at the Joint Session of the Association of American Geographers and the Geological Society of America, 1918.

J. W. Bagley and Fred H. Moffit (Introduced).

A Method of Aerial Photo-Topographic Mapping.

The construction of maps from photographs has been practiced for many years but the use of air plane photographs for this purpose did not become practicable till after the outbreak of the present war when the necessities of the operations on the different battle fronts led to very extensive use of air plane photography for this purpose. Nearly all the maps so far constructed consist of single photographs having a narrow angle of view and therefore covering only a small field. The photographs are taken in a more or less unsystematic way and are joined together without corrections for errors other than that of scale. These maps are commonly called "mosaics."

In order to increase the speed of working and decrease the cost of the map as well as to carry out the work in a better and more systematic way, a multiple camera with inclined plates has been designed so that three overlapping photographs covering a large field may be taken simultaneously. Deviation of the plates from a horizontal position, due either to the attitude of the air plane or to the construction of the air plane camera, introduces errors of distortion so that the photographs are not true maps of the areas covered. These errors are corrected by projecting the negative photographically on a horizontal plane in accordance with principles first described by an Austrian army engineer, Capt. Theodore Scheimpflug. The photographs are then brought to the desired scale and joined together to form the map. Special cameras for correcting the errors mentioned have been designed and are now in use by the Corps of Army Engineers, but much remains to be done before the method is perfected.

Albert Perry Brigham.

Principles in the Determination of Boundaries.

Discusses physical boundaries and human factors in boundary making, and arrives at the following conclusions:

The present arrangement of human groups is a heritage from long existing biological conditions of dispersal, migration, and intermingling, complicated by the vagaries of the human will, as seen in lust of conquest, love of war, dynastic ambitions, and economic greed.

The necessity of boundary lines has come with the filling of the world's spaces, the pressure of population on resources, and the lifting and widening of the material standards of living.

We hold with Lyde that civilization is "progress in the art of living together." Any nation is backward in civilization in proportion as its standards of international dealing fall below its laws of intranational conduct.

We do not accept Holdich's virtual admission that international ethics are permanently so low that defensive boundaries will always be essential to reasonable safety against attack.

On the other hand we are not convinced that boundaries should be deliberately and always placed where people meet. We would not avoid such lines if the greater justice to the greater number on both sides of the proposed fence seems to require them. We might for the present give questionable or quarrelsome neighbors as high a fence as is practicable, as we try to keep the weak of all sorts from overpressing temptation.

Approximately twenty-five human groups in Europe show such unity of purpose and ideal, such community of interest, of history and of hopes, and each in such reasonable numbers, that they have embarked or deserve to embark on a career of nationality.

The world is now pretty well agreed that ruling houses are obsolete, that the interests of great powers are no more valid than those of small powers, and that economic equilibrium or self sufficiency in natural resources does not outweigh the rights and desires of any truly national group.

Europe has an exceptional number of physical units which in primitive days could serve as the cradles of nations. In the advanced conditions and high densities of today, however, the number of physical compartments falls far short of the number of groups which properly wish independence.

Modern appliances for war have impaired the security once gained through physical barriers. Heights of land and all kinds of waters give important aid in war, but they do not fend off war. We cannot destroy the germs of frontier dispute by drawing physical boundaries."

We must draw boundaries on defensible or separating lines if possible but at all events in such a way as to work substantial justice.

Here is the sphere of a league of nations, embodying the will of all mature civilization that imperfectly civilized groups shall no longer make biological inferences or blasphemous conceptions of divine destiny the excuse for perpetuating tooth-and-claw methods in the relations of peoples. (See Geographical Review for April, 1919, pages 201-219.)

M. R. Campbell.

Geographic Descriptions of Army Cantonments and of United States Boundary Regions.—Read by Title.

Oliver L. Fassig.

The Signal Service School of Meteorology.

In the fall of 1917 a Meteorological Division of the Signal Corps of the Army was formed under the supervision of the Science and Research Department in co-operation with the U. S. Weather Bureau. About 200 men mostly drawn from our colleges received two months' special training as weather observers at selected stations of the Weather Bureau.

In the spring of 1918 a special school for this training was established at the Agricultural and Mechanical College of Texas, at College Station. The instruction staff consisted of the writer as Chief Instructor, Dr. Chas. F. Brooks of Yale University, Lt. W. S. Bowen of the Signal Corps, and Mr. W. T. Lathrop of the Weather Bureau, as Assistant Instructors. The military instruction and drill were given by the Commanding Officer of the Meteorological Division, Lt. H. B. Hovde and his staff.

The class consisted of 300 men, mostly civil, mechanical and electrical engineers, and instructors in physics, chemistry and mathematics, including about forty men with previous training in the Weather Bureau.

The daily schedule of technical studies included the following:

1. A lecture on general meteorology or aerology.
2. Frequent cloud studies in the field.
3. The construction and interpretation of the daily weather map based upon daily telegraphic observations from 75 Weather Bureau stations.
4. Daily observations such as are made at all first order stations of the Weather Bureau.
5. The preparation of meteorological forms.
6. Thorough and practical field instruction in the use of the theodolite for determining the paths of small rubber balloons which were filled with hydrogen and liberated. These balloons indicated the varying directions and velocities of the atmospheric currents to heights of many miles above the surface of the earth.

The high grade of men composing the class made it possible to develop many new mechanical devices and quick methods for reducing observations for determining the ballistic wind in the correction of long range artillery fire. The projectiles fired from the large modern guns not only have a range exceeding 20 miles, but they are carried to elevations of 10 or more miles above the earth's surface—into regions where the wind velocities and directions differ widely from those prevailing at the surface.

An intimate knowledge of the temperature and density of the air and of wind velocities and directions, is indispensable in attaining

accuracy in long range artillery fire, and in anti-aircraft operations, in charting upper air currents for commercial aviation, and in selecting safe landing places for the aviator of the future.

At the time of the signing of the armistice about 500 men had been given special training as weather observers in the Signal Corps of the Army, for a period of from two to three months. About 300 of these men were sent overseas, and about 200 were retained in this country and assigned to duty at a score or more of the flying and artillery fields, at ordnance camps, balloon schools, and with radio detachments for the purpose of supplying these branches of the Army with the meteorological information desired by them. Twenty-five of the men of the School were transferred to the New London Naval Station for further instruction in connection with the development of the hydrophone, an instrument designed to detect the presence and locate the position of submarines.

(See Monthly Weather Review for December, 1918, pages 560 to 562.)

C. K. Leith.

Internationalization of Mineral Resources.—Read by Title.

F. E. Matthes.

The American Topographer in the Rôle of Artillery Orientation Officer.

When the United States went into the war its artillery arm possessed practically no trained artillery orientation officers, and was not prepared to execute long range artillery fire of the kind that has played so important a part in this war. Civilian topographers, mostly from the Geological Survey, were trained for this work by French officers and were found to be particularly well fitted for it by reason of their previous training in topographic survey methods. In a few months they became expert enough to hold their own against the highly trained artillerists of the enemy.

The principles of modern artillery orientation were outlined and examples of plane table and other surveys were sketched upon a blackboard.

Eugene Wesley Shaw.

Mexican Petroleum and the War.

The part played by petroleum and its products in the great war is a subject of general discussion, but there seems to be agreement that this

part was very essential both in comparison with other war minerals and in comparison with other elements that contributed toward success. The value of Mexican petroleum involves peculiar factors, though like the value of other available oil supplies, it has been controlled mainly by quantity, quality and accessibility.

The quantity factor has had the following outstanding features: The country is the third largest producer in the world and furnishes roughly one-tenth of the total supply. Eight years ago the output of the country was scarcely one-twentieth as great as in 1918 and the fraction of the world's output was only about one per cent. Twenty years ago the pools were undiscovered. On the other hand the aggregate capacity of the wells already drilled has differed from those of other regions in that it has always been far above the actual output; also if conditions of development had been as favorable as they are in some parts of the world there would have been many more wells drilled and a far greater supply of oil would have been available—perhaps twice as much as all the world is now producing. The country has the largest oil wells in the world and the main part of the output has come from a very few wells. Roughly, half of the output of the country in 1918 was used in connection with the domestic and military requirements of the United States, and of the capital invested in Mexican oil nearly two-thirds is American.

As to quality, the peculiar features of Mexican petroleum lie in the relatively low percentage of light distillates and the relatively high sulphur content. It furnishes little gasoline in comparison with its bulk, and this percentage has not been raised to a high figure through cracking processes. However, Mexico offers an immense reserve of fuel oil, though for fuel much of the oil needs an admixture of more fluid oil, or special burners adapted to its high viscosity. Its percentage of undesirable sulphur is reduced most readily by the addition of sulphur-free oil.

The accessibility depends on many considerations, including its distance from the points where it is refined and used and from the sources of labor and supplies, upon the tankers, pipe lines and other transportation facilities available, and upon political conditions in and around the fields, arising out of local disturbances and the decrees issued by the Mexican Government, involving high taxation (15 to 20 per cent.) or nationalization, or threatened "confiscation of private property, and arbitrary deprivation of vested rights." The area in which the fields are located is small relative to the quantity produced, and it borders on the sea. If sufficient tankers had been available, the production for 1918 would have been five to ten times greater.

Glenn S. Smith (Introduced).

American Mapping in France.

Organization for topographic work in American Expeditionary Force. Magnitude of job undertaken and necessity for special speed. Opportunity to test American methods in comparison with those of the British and French.

Joseph B. Umpleby.

World View of Mineral Wealth.

INDEX

ASSOCIATION OF AMERICAN GEOGRAPHERS

Officers, 1919

President
CHARLES R. DRYER
Fort Wayne, Indiana

First Vice-President
HERBERT E. GREGORY
New Haven, Connecticut

Second Vice-President
ISAIAH BOWMAN
New York City

Secretary
OLIVER L. FASSIG
San Juan, Porto Rico

Treasurer
FRANÇOIS E. MATTHES
Washington, District of Columbia

Councillors
(Term expires 1919)
ALBERT PERRY BRIGHAM
Hamilton, New York

(Term expires 1920)
WALTER S. TOWER
New York City

(Term expires 1921)
ELIOT BLACKWELDER
Denver, Colorado

Committee on Publication

CHARLES R. DRYER
Fort Wayne, Indiana

NEVIN M. FENNEMAN
Cincinnati, Ohio

RAY H. WHITBECK
Madison, Wisconsin

RICHARD E. DODGE
Chairman and Editor, Storrs, Connecticut

PRESS OF
THE BRANDOW PRINTING CO.
ALBANY, N. Y.